Report to the UF Water Institute: Study on Springs Basin Working Groups*

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Springs in Florida have enormous economic and ecological value. In recognition of this value, Florida's governor and legislature established the Florida Spring's Initiative in 2001, outlining projects regarding the research on, education about, and management of Florida's springs. Among the programs included was the development of community working groups consisting of members from federal, state, regional, and local agencies as well as members of the local communities. Through this initiative, six Springs Basin Working Groups (SBWG) have been supported by the Florida Department of Environmental Protection (DEP), and in 2010 were the focus of this qualitative research study.

There is a growing trend in resource management—particularly in the context of broad-scale systems—not to rely on a purely top-down system in which information and decisions originate only from one governing agency. Many resource managers and scholars suggest that due to the complexity of these systems, managing them requires input and insight from multiple scales of government and from non-governmental stakeholders. The SBWGs were of academic interest in that they appeared to be designed to facilitate communication between multiple agencies and between government scientists and private citizens. This study was developed to gain a better understanding of how SBWGs function and how participation in these groups affects members' perceptions of the spring systems. In addition, the study explored how the working group members view the working groups themselves. Specifically, are they seen as effective tools in the restoration of Florida's springs and what, if any, role do they play in that context?

SCOPE OF STUDY AND ACQUISITION OF STUDY RESPONDENTS

The Ichetucknee, Jackson-Blue, Rainbow, Santa Fe, Silver, and Wakulla Springs Basin Working Groups were included in the scope of the study. Members of the research team attended each group's quarterly meeting from December 2009 to February 2010 where they described the study and asked members to signup to learn more about the interview process. In groups where the list of volunteers from the meeting was not sufficient for the study, SBWG coordinators provided the names of people who would likely be helpful as respondents. Potential interviewees were then contacted by phone or email to explain the project, to set interview appointments, and to obtain their consent to be interviewed (in some cases, consent was obtained at the interview appointment).

The selection of study respondents was not random. Given the exploratory nature of this study, it was decided that obtaining input from individuals who were particularly active within the groups or who could provide a specific perspective (e.g., government scientist, environmental action, concerned citizen) was more important than any potential statistical advantages of random sampling. The respondents were chosen so that they collectively would represent the range of people attending working group meetings.

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RESEARCH TOOLS AND METHODOLOGY

As this was an exploratory study, in-depth interviews were used as the primary research tool. After reviewing available literature and content from SBWG websites, SBWG coordinators were interviewed to ascertain the official goal and basic model for each working group. These interviews provided information about how long each group had been meeting, typical meeting agendas or other group events, typical meeting participants, ancillary community groups related to the springs, and major issues or concerns the group has addressed.

Based on this information, a list of questions was developed to guide a discussion with working group members. These were open-ended questions (Appendix) designed to provide insight into study participants' perspectives regarding the health of the spring systems and the role and success of the SBWGs. In addition to the open-ended questions, a cognitive mapping technique was used to better assess participants' opinions about the most important variables affecting the health of the springs.

Cognitive Content Cognitive Mapping (3CM) is a useful tool for measuring knowledge structures (Kearney and Kaplan 1997; Byrch *et al*. 2007). It is a card sorting technique, requiring participants to identify key aspects of a situation or topic and to make associations between those aspects. After answering the open-ended questions in the interview, participants were given a prompt asking them to identify the "things" that are most important to include when explaining the springs ecosystem to a person who has never been to the springs before.

When using the 3CM method, subtle changes in the prompt can greatly affect the character of the map that a participant provides. For that reason, it is important to pilot test the prompt repeatedly to ensure that participants are providing the desired type of information. For example, early drafts of the prompt asked participants to discuss the "springs" rather than "springs ecosystem health." This difference led pilot test participants to focus on their personal experiences at the springs or on physical characteristics, such as karst topography, rather than on human impacts and food webs, which was the desired focus. The shift to "ecosystem health" cued participants to focus on less abstract aspects of the springs ecosystems.

There are two versions of 3CM: open-ended and closed. In the open-ended version, participants respond to the prompt by listing all the things that come to their mind regarding the health of the springs, and the interviewer writes down each concept or thing listed by the participant on a separate card. In the closed version, participants are given a stack of pre-made cards and asked to choose cards expressing concepts or things they think are relevant. In both versions of 3CM, the participant is then asked to place the stack of identified or chosen cards into groups based on whatever criteria they choose and to give each group a descriptive title. This step provides a sense of the associative relationships that the participant sees between the concepts. The identification of key things/concepts and their placement into associated groups constitutes a cognitive map. For this study, the final step of the mapping exercise was to ask the participants to explain the reasoning behind their choices. This step helps the researchers interpret the groupings appropriately and identify similarities among individuals' groups.

The open-ended version of 3CM was used during the early pilot tests. In addition to providing feedback about changes needed for the prompt, responses to these interviews were used to develop a list of things/concepts that pilot participants considered relevant when considering the health of the springs ecosystems. Concepts on this list were used for additional pilot tests and reviewed by three springs experts. The final list was used for the closed version of 3CM, which was the primary tool used for interviews with SBWG members. This version allows participants to select the things/concepts that they believe are important, and the common set of cards used by participants facilitates direct, quantitative comparison of participant maps. Participants working through the closed 3CM exercise chose from a list of 52 things/concepts (Appendix). They were also provided the opportunity to add things that were not included in the list.

A total of 35 SBWG members were interviewed with interviews ranging from just over 30 minutes to almost two hours. Four to seven members were interviewed from each group (Table 1). Participants were interviewed in places of their choice, including in homes, at their offices, or in convenient public areas. All of these participants responded to the set of open-ended questions. In all but one case, participants agreed to be tape-recorded. These recordings of the interviews were transcribed for analysis. We obtained five open-ended 3CM maps and 26 closed 3CM maps. (In three interviews, 3CM maps were not collected due to a time constraints or respondent preference.) In the final stage of the interviews, participants were asked to complete a worksheet regarding the causal relationships between algae growth and a number of variables (Appendix).

Table 1: Number of SBWG Member Interviews

Working Group	Number of Interviews
Jackson Blue	4
Ichetucknee	6
Wakulla	6
Silver Springs	6
Rainbow	6
Santa Fe	7
Total	**35**

Three types of data were obtained from the interviews: transcripts of interviews, 3CM maps, and written responses to the algae growth worksheet. To analyze the transcripts, four members of the research team read each of the interview transcripts and coded the relevant themes. Over the course of several meetings, research team members identified themes and topics that arose repeatedly. Once a set of themes were identified, researchers went through the transcripts again, this time looking specifically for input on those themes that seemed particularly important to the participants. Analyzing the 3CM maps involved a number of quantitative measurements that are explained in the following section. Finally, the worksheet on potential variables affecting algae growth was analyzed using descriptive statistics; analysis was also performed to determine statistically significant results at $p<0.05$.

RESULTS AND DISCUSSION

SBWG Goals

The first stage of analysis was to understand how the SBWGs function. The Florida DEP established the working groups with the following purpose: "To **educate stakeholders** about the spring basin and **develop and implement tasks** to protect surface and groundwater flowing to

the spring" (Florida DEP 2008). Table 2 provides the dates that each of the SBWGs in this study were launched. Note that in some cases, the working groups were established before 2002, when the DEP's funding for the groups began. While the details of the contracts for the SBWG coordinators vary slightly, they are all charged with the following objectives, taken from contracts between the DEP and SBWG coordinators:

Table 2: Founding Dates for SBWGs

Working Group	Date
Wakulla	1992
Ichetucknee	1995
Santa Fe	1998
Silver	1999
Jackson Blue	2005
Rainbow	2008

- Develop and maintain list of local stakeholders
- Conduct quarterly meetings with agenda and minutes
- Assemble existing spring basin maps, reports, and summarize monitoring data
- Identify research and monitoring needs, and recommend projects
- Identify threats to springs and actions to take in response to threats
- Organize a special event (springs day, festival, old timer day)
- Conduct basin field trips and presentations to the public or organizations
- Recognize Springs Champions with Spring Task Force Awards
- Communicate with landowners, elected officials, and business leaders
- Identify and support land acquisitions

Among these objectives, the quarterly meetings appear to be the focus for most coordinators. The quarterly meetings are held on weekdays and typically last about six hours. An agenda listing presentations planned for each meeting is sent out prior to the meeting. Sometimes, these agendas have a theme that connects the various presentations, such as septic tanks. The field trips and special events are often connected with the quarterly meetings. Coordinators stressed that the primary goal of the SBWG was to share information during the quarterly meetings.

This sentiment was echoed by SBWG members. In their view, the main purpose of the SBWGs is education and information exchange. Members were quick to point out that the SBWGs are not political or advocacy groups, and they stressed the importance of not being seen as such. When asked whether the group participates in activities or makes recommendations as a group— for example, regarding projects, monitoring needs, or threats—most respondents explained that these things went beyond the scope of the group.

> *"There are political implications, and [the coordinator] has tried really hard to make it where that's not really what the function is. It's really a matter of getting all of the information out there."* RS4
>
> *"[Becoming an activist group] would keep some people from being a part of the group. Agency people wouldn't be in the group, they wouldn't be at the table if we were an advocacy group or an anti-group. That's being an advocate of an opponent."* IC5
>
> *"The work group… has just been informational. It hasn't tried to be decision-making. It's been visioning in an unstated kind of way in that we're looking at the springs and Jim's picking the speakers and who's there, and then people are just volunteering the ideas and what they're doing."* WA4

Members cited a number of reasons for focusing purely on information, rather than recommendations. First, many SBWG members, including the scientific experts, are employees of state and federal agencies. While they are able to represent their respective agencies when conveying information regarding scientific results,

they do not perceive that they have the authority to discuss or endorse recommendations made by the SBWG. Some members perceive the agency members are even unlikely to raise questions of presenters, in case the discussion becomes controversial. Other members suggest that the power of the SBWGs lies in their role as sources of unbiased, scientific information. Any shift away from a purely informational role could sully a SBWG's reputation as an unbiased authority.

Some members expressed disappointment regarding the purely informational role. One member from Santa Fe Springs explained, "It is more just information dissemination and I had more advocacy in mind, to be honest. I probably will have to pursue that myself with some other existing group." Indeed, many of the members wear multiple hats and use the SBWG as an information source to support their more activist endeavors. As one member explained, "We are not in a position that we can be action oriented as a group, but we can disseminate the ability to take action through letting people know what other things are going on." In other words, SBWG members are able to use the scientifically credible information gleaned from the working groups to guide their efforts and to support arguments for policies or actions advocated by their openly political advocacy group. Indeed, some members see the environmental groups' participation as a significant benefit of the SBWGs; the groups enable the activists to receive information and coordinate their activities.

Several non-activist SBWG members also referred to the importance of this role. As one government employee from Silver Springs observed, "Being a state employee I can't lobby anybody, which is good, but we do need some of those personalities who are tenacious and pessimistic, who will go out and just worry at those people who need to be worried at." One member from Silver Springs described this process in the context of a specific change in policy that he attributed largely to the efforts of the SBWG: "What we did was present the facts from the springs group, while some of the other groups that had the ability to take more action could in fact write letters and do things that the springs working group [was unable to do]."

Make-Up of the Groups

Study participants unanimously cited diverse membership as one of the benefits of SBWGs and believe that this diversity is essential to achieving change with the springs systems. Indeed, members represent many different backgrounds and an assortment of government agencies. Participants most commonly mentioned that scientists and experts specializing in different areas and who represent multiple agencies, such as the Water Management District, Florida Geological Survey, and Florida Department of Health, attend the meetings, along with concerned citizens who live nearby. Fewer participants mentioned that local politicians, local businesses, and city or county staff attend the meetings.

The diversity within the SBWGs, however, is somewhat limited in that all of the members attend the meetings because they are concerned about the health of the springs ecosystems and wish to see it protected, either as a component of their employment or their personal interest. For example, one participant noted, "I think virtually—with one or two exceptions—everybody that I've met at those meetings shares a strong concern for the future of this spring or other springs." Several members identified under-represented perspectives, such as land developers and owners of large farms, and that activities of these stakeholders can have significant impact on the springs.

Some members pointed out that since no decisions regarding policy or regulations are made at these meetings, there is little incentive for these stakeholders to attend. In addition, because the discussion about the springs assumes some background and can be rather technical, new members to the SBWG may be discouraged; most participants have more familiarity with springs ecology than the general public.

Most of the respondents considered the relatively high levels of discussion a positive aspect of the meetings, suggesting that the meetings would not be as informative if the presenters were forced to repeatedly cover basic ecological concepts. Several non-expert respondents explained that if they did not understand something, it was their responsibility to learn about it, either through questions after the presentation or from other group members later. In addition, coordinators often ask questions that help to clarify key points for everyone. While respondents were generally quite pleased with the presentations, Table 3 provides a list of common suggestions offered by respondents regarding for future presenters.

Table 3: SBWG Member Suggestions for Future Presenters

Presentation Suggestions
• Provide handouts that summarize main points of presentation
• Make PowerPoint presentations available on-line (preferably before the presentations so that people can prepare
• Avoid acronyms when possible
• Eliminate jargon and clarify all terms used in presentation
• Make the information relevant and personal—"talk with people rather than to them"

The high level of scientific literacy among group members creates an interesting dynamic regarding scientific uncertainty. Typically, members of the general public are not comfortable with scientific uncertainty. As a result, the uncertainty inherent in the study of complex ecosystems often becomes a point of frustration or confusion among the general public. The confusion and incredulity expressed by some members of the general public regarding climate change stems largely from this difficulty. Study respondents, however, were typically quite comfortable with the idea that many uncertainties exist and that scientific models and explanations for the behavior of those ecosystems will likely change over time.

SBWG Accomplishments

The attribution of policy changes to the efforts of the SBWGs is itself an interesting dynamic. Table 4 lists several improvements regarding springs policy that working group members attribute to the SBWGs. Coordinators of these groups were less inclined to view some of these changes as direct outcomes of SBWG efforts. The inconsistency appears to be due to several factors. First, as explained above the SBWGs do not take direct action regarding springs health.

Table 4: Accomplishments Attributed to SBWGs

Working Group	Accomplishment
Wakulla	Attracting press coverage for springs issues.
Wakulla	Retrofitting wastewater disposal facilities to reduce nutrient load within spring shed.
Ichetucknee	Land acquisitions.
Ichetucknee	Shifting social norms to include concern for the springs
Silver	Land acquisitions.
Silver	Retrofitting highway drainage systems to reduce run-off directly into springs

Rather, particularly active members use the information conveyed during SBWG meetings to direct their efforts. One participant from Wakulla Springs explained in detail how this model creates change in a rather organic way:

> No one knows what everyone else is doing. So if everyone comes and tells what they're doing the whole group will know more: will have more technical information, will be able to solve problems.… For instance there might be somebody from the Northwest Florida Water Management District and a topic of discussion in the meeting is that we don't know anything about the hydrology of the Woodville Karst plain. And they may decide, "Well let's do some potentiometric surface surveys of the wells in the area." So they'll go back and they'll ask their supervisor and get a project funded and they'll go out and do that.

This example focuses on a hypothetical government employee, but the same organic call to action was described by advocates as well. Thus, the SBWG meetings are often identified as the genesis of ideas for studies and policy changes that eventually led individuals or sub-groups to the types of accomplishments in Table 4.

> *"This is huge stuff and it can all be traced back to the knowledge and information that are built up over the years from the working group."* WA2
>
> *"Now everyone knows the Ichetucknee has to be looked at as a priority before they can do anything in this county. And that to me is incredible. Anywhere you go, you can talk about springs and people will say, yes, the Ichetucknee.… The ground work has been done is invaluable and has changed the whole community. The builders, to think that we ever got everyone to sit down at the same table about brings tears to my eyes."* IC2
>
> *"Now, you have where our farmers have changed their way of applying fertilizers and they've also changed their irrigation so to have the mist instead of the spray. Not all of them, but most of them. They're not using as much water. They're using just enough for the plants to take."* JB2

There is no doubt that the exchange of information during the SBWG meetings has greatly improved communication and helped to coordinate efforts between state, regional, and federal agencies as well as between concerned citizens. However, in the case of several of the accomplishments attributed to the SBWGs, there is some question as to the importance of the role played by the SBWG itself. In the case of the Tallahassee spray fields, for example, it is difficult to know now whether the SBWGs represented a key turning point for some of the accomplishments listed, or whether those accomplishments were already topics of discussion when they were introduced to SBWGs.

In addition to the information exchanged at the meetings, many members also cite educational efforts by the SBWGs, including organizing annual festivals and producing educational posters. Other groups have had road signs printed to help raise public awareness regarding the springshed. These activities are seen as a way that group can conduct education and be active without being political.

Springs Ecosystem Health

Analysis of the 3CM maps developed by study participants showed a strong focus on nutrients entering the spring system with Fertilizers, Nitrates, and Septic Tanks as three of the top five most chosen cards. Aquifer and Water Quality were the other two. Several participants describe a model in which increased development (including agriculture) causes increased nutrients in the

springs, which leads to increased algal growth. Other aspects of springs ecosystem health, such as Groundwater Recharge and Springs Recreation, were often included. Table 5 shows some of the most notable differences between responses.

Table 5: Concepts Included in Respondent Cognitive Maps (by percentage)

	Ichetucknee (n=3)	Jackson Blue (n=4)	Rainbow (n=5)	Santa Fe (n=4)	Silver (n=5)	Wakulla (n=5)
Nitrates	0.67	0.75	1.00	0.75	0.80	1.00
Development	1.00	0.25	1.00	0.50	0.80	0.80
Crop Agriculture	0.67	0.50	0.80	0.50	0.00	0.20
Springs Recreation	0.33	1.00	0.80	0.25	0.80	0.20
Run-Off	0.33	0.75	0.80	0.50	0.60	0.60
Sinkholes	0.67	1.00	0.40	0.25	0.20	1.00

Maps from agency scientist participants (n=6) were compared to those from non-scientists (n=12) to assess whether the model of springs health proposed by scientists within SBWG groups was being adopted by non-scientists. Cards listed in the previous paragraph were chosen often by both groups. However, the proportion of scientists including Water Conservation in their maps was almost twice that of non-scientists. The number of participants is too low here to draw any conclusions, but this may point to a part of the prevailing scientific model of the springs as expressed by agency scientists that has not been picked up by non-scientists.

Analysis of the algae worksheet provided additional findings concerning one specific spring health issue: how increases in several different factors would affect algae levels in the spring and spring run. Participants were asked to score each factor on a scale of 0 to 3, with 0 meaning an increase in the given factor would "Not at all" affect algae levels, and 3 meaning an increase in the given factor would affect algae levels "A lot" (n=32). Participants could also mark "Not sure" for each factor. Similar to the focus of participants' mental models, the factors receiving the highest scores for affecting algae growth are Nitrates and its common sources (Table 6). These factors were typically reported as increasing algae levels in the spring run.

Table 6: Factors Affecting Algae Levels in the Spring and Spring Run

Factors	Average	n
Nitrates	2.97	32
Fertilizers	2.78	32
Septic tanks	2.55	31
Wastewater treatment plants	2.55	31
Crop agriculture	2.53	32
Animal agriculture	2.48	31
Run-off	2.45	30
Phosphorus	2.16	31
Aquatic plants (other than algae)	1.77	26
Recreational users	1.59	27
Dissolved oxygen	1.37	19
Pesticides	1.29	17
Microorganisms	1.23	13
Acid Rain	1.14	14
Aquatic animals	1.04	24

Note the factors with smaller sample sizes are because high frequencies of respondents did not use the scale to score the factor and instead marked "Not sure" or left the question blank. Specifically, several participants were unsure of how increases in Acid rain, Dissolved oxygen, Microorganisms, and Pesticides would affect algae levels. In contrast, all participants were able to answer the question for factors such as Nitrates, Fertilizers, and Crop agriculture.

Similar to the 3CM analysis, some differences were found between how non-scientists and agency scientists responded to this question. In particular, scientists rated Fertilizers, Microorganisms, and Pesticides as playing a smaller role in affecting algae levels than non-scientists, while rating Wastewater treatment plants and Dissolved oxygen as playing a larger role in affecting algae levels than non-scientists (Table 7). Due to the small sample sizes, only Microorganisms shows a statistically significant difference between the responses of non-scientists and agency scientists, but these results suggest some of the differences one might see more clearly with a larger data set.

Table 7: Comparison of Factors Affecting Algae Growth by Scientists and Non-scientists

Factors	Non-Scientists			Scientists		
	Average	n	Std Dev	Average	n	Std Dev
Acid Rain	1.25	4	1.26	1.00	3	1.00
Animal agriculture	2.45	11	0.93	2.40	5	0.55
Aquatic animals	0.90	10	0.88	1.25	4	0.96
Aquatic plants (other than algae)	1.90	10	0.88	2.00	5	1.22
Crop agriculture	2.58	12	0.67	2.40	5	0.55
Dissolved oxygen	0.83	6	0.98	1.60	5	1.14
Fertilizers	2.92	12	0.29	2.60	5	0.55
Microorganisms*	2.00	3	1.00	0.00	3	0.00
Nitrates	3.00	12	0.00	2.80	5	0.45
Pesticides	1.33	3	0.58	0.60	5	0.89
Phosphorus	1.64	11	1.12	2.00	5	1.22
Recreational users	1.55	11	0.93	2.00	5	1.22
Septic tanks	2.45	11	0.82	2.40	5	0.55
Run-off	2.27	11	0.79	2.40	5	0.55
Wastewater treatment plants	2.27	11	0.79	2.80	5	0.45

CONCLUSIONS

It is clear that study participants view the SBWGs as playing an important role in efforts to educate citizens and change the social norm about springs protection, that will eventually help to improve the health of springs ecosystems. The primary benefits of SBWGs as perceived by study participants include attracting a diverse membership; increasing communication between government agencies, NGOs, and the general public; and conducting outreach and education. Most participants believe that the strict adherence to an information-only model in necessary for SBWGs to maintain their function of providing credible scientific information about springs ecosystems (assuming no change in organization).

The focus on information exchange has some potential shortcomings. First, the flow of information originates largely from scientific experts who are not typically working group participants. While this is an important flow of information, SBWG meetings could also be a rich source of insights from non-scientists. However, the input from public citizens seems to be

largely in the form of questions clarifying points made by presenters. Expanding the scope of the meetings to include possible approaches to current management challenges could provide an opportunity for gaining insights and opinions for a variety of stakeholders at the meetings. Second, while participants cite the diversity of the group as a primary benefit, most recognize the absence of several key stakeholders such as those who have businesses in the area, farmers, and average citizens. However, those stakeholders are unlikely to attend meetings under the information-only model.

Expanding the scope of the SBWGs to include discussion of restoration activities or policy implications of scientific findings may create other problems, such as alienating current SBWG members who support the current model and even opening the SBWGs up to criticism of being politically biased. In deciding future models for SBWGs, DEP officials must way the potential benefits of having a greater degree of input from a broader range of stakeholders with the added difficulties that would be involved in introducing policy discussions to the workings of SBWGs.

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Appendix: Interview Materials

Interview Script

1: First, can you tell us how you became involved in the springs working group?
2: What is your idea of the area included when someone says the word "springs?"
3: Are you thinking of a particular spring or a collection of springs in the region? Which one(s)?
4: What is your sense of the current health of the springs?
5: What is your sense of the future health of the springs?
6: Do you think other members of the working group share your view about springs' health?
7: Do you interact with any of the members outside of the quarterly meetings or planned working group events?
8: Where do you typically get your information about the springs?
9: Which of these sources do you trust the most to give you accurate, reliable information about the springs?
10: Are there any sources you trust less than others?
11: How would you describe your attendance to the Springs Working Group meetings?
12: Can you describe a typical scientific presentation at your working group meeting?
13: What makes it easy or difficult to understand a scientific presentation?
14: What would make these presentations better?
15: How would you feel if a scientist said, "There's a lot we don't know about this issue, here is one possible explanation, but there may be other important factors?"
16: How would you describe your participation in the meetings?
17: Is a diversity of perspectives or opinions about the springs represented by the group?
18: What advantages or disadvantages do you see to having diverse perspectives within the group?
19: Does the group decide on activities to participate in and recommendations to make concerning the springs?
20: Imagine in a few years you read a newspaper article that says, "the ____ working group has been very successful in meeting the goals of the group!" Can you describe what a successful springs working group looks like to you?

Closed/Structured 3CM Prompt: Let's presume you have a friend that's never been to the spring and doesn't know anything about it. They're interested in learning more information and they know that you're a springs working group member. What types of things would be important for him or her to understand about the health of the springs ecosystem?

Categories for Closed 3CM Exercise

1. Algae
2. Animal agriculture
3. Aquatic animals
4. Aquatic plants
5. Aquifer
6. Boats
7. Bottling companies
8. Cement plant
9. Clarity
10. Climate change
11. Connectivity
12. Crop agriculture
13. Development
14. Dissolved oxygen
15. Education
16. Fertilizers
17. Filtration
18. General tourism
19. Groundwater
20. Groundwater recharge
21. Habitat/natural community
22. Human Population
23. Infiltration
24. Invasive plants
25. Irrigation
26. Limestone
27. Management agencies
28. Municipal water
29. Nitrates
30. Non-aquatic animals
31. Paved or impervious surfaces
32. Pesticides
33. Pharmaceuticals (in water supply)
34. Phosphorus
35. Private wells
36. Rain
37. Run-off
38. Scientific uncertainty
39. Septic tanks
40. Sinkholes
41. Soil erosion
42. Springs recreation
43. Sun
44. Surface water
45. Terrestrial plants
46. Trash
47. Water conservation
48. Water flow
49. Water quality
50. Water temperature
51. Water velocity
52. Watershed

Algae Worksheet

How much do you think increases in each of the following factors affect algae levels in the spring and spring run?

Factor	Not at all	A little	Some	A lot	I'm not sure	Increase or Decrease Algae
Acid Rain	0	1	2	3	□	↑ ↓
Animal agriculture	0	1	2	3	□	↑ ↓
Aquatic animals	0	1	2	3	□	↑ ↓
Aquatic plants (other than algae)	0	1	2	3	□	↑ ↓
Crop agriculture	0	1	2	3	□	↑ ↓
Dissolved oxygen	0	1	2	3	□	↑ ↓
Fertilizers	0	1	2	3	□	↑ ↓
Microorganisms	0	1	2	3	□	↑ ↓
Nitrates	0	1	2	3	□	↑ ↓
Pesticides	0	1	2	3	□	↑ ↓
Phosphorus	0	1	2	3	□	↑ ↓
Recreational users	0	1	2	3	□	↑ ↓
Septic tanks	0	1	2	3	□	↑ ↓
Run-off	0	1	2	3	□	↑ ↓
Wastewater treatment plants	0	1	2	3	□	↑ ↓
Other, _____:	0	1	2	3	□	↑ ↓
Other, _____:	0	1	2	3	□	↑ ↓