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# MEMORANDUM

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Date: February 25, 2002

To: The Honorable Chair and Members  
Pima County Board of Supervisors

From: C.H. Huckelberry  
County Administrator 

Re: **Adaptive Management Workshop**

## I. Background

Pima County and the Arizona Open Land Trust have held a number of workshops to support the Ranch Conservation Element of the Sonoran Desert Conservation Plan. The proceedings of the Conservation Easements workshop and the Tax and Estate Tax Planning workshop have been published. The verbatim proceedings and materials from the Adaptive Management workshop are attached.

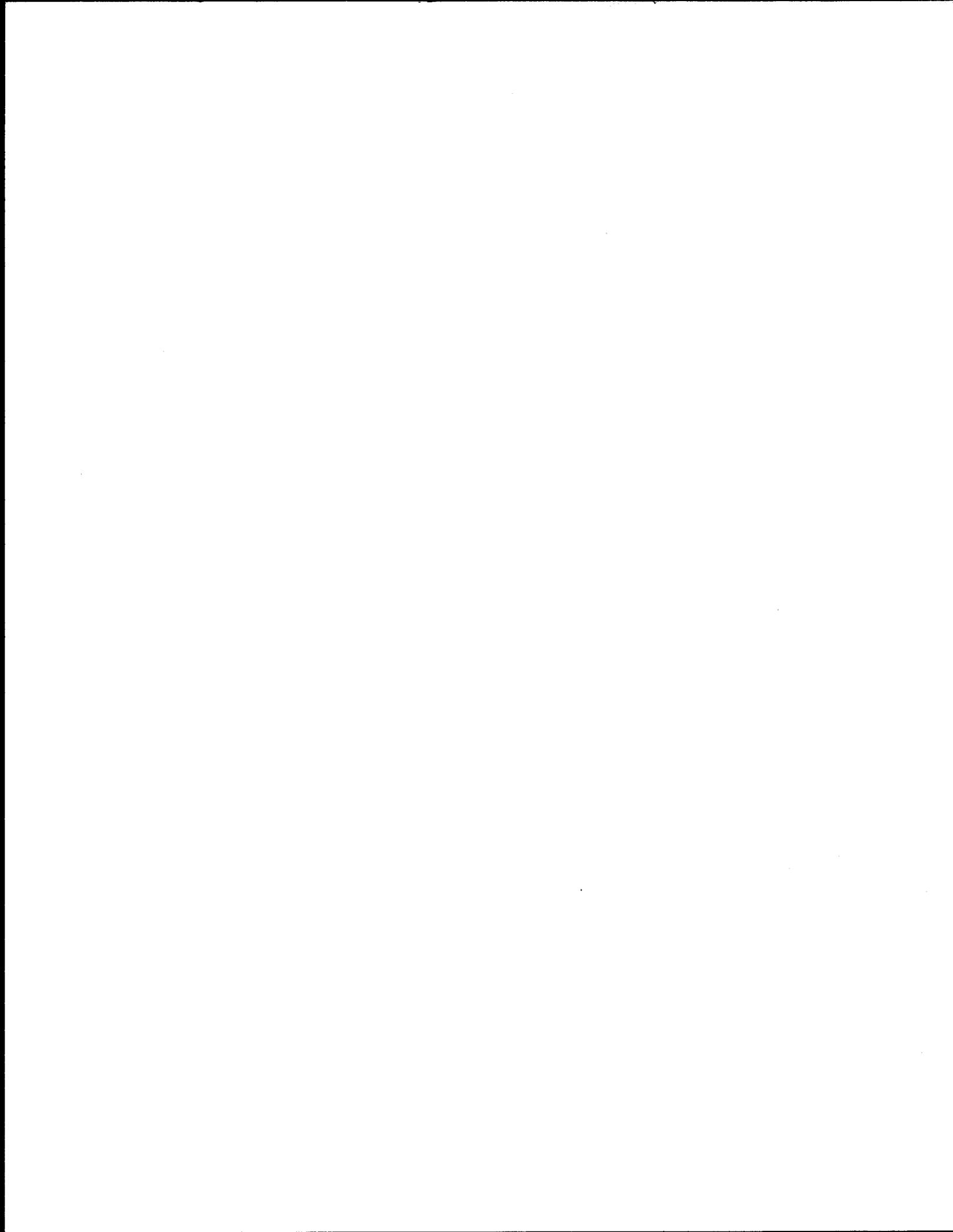
## II. Adaptive Management and the Sonoran Desert Conservation Plan

A 2001 workshop on adaptive management featured seven speakers: (1) Dr. Bill Shaw, Chair of the Science Technical Advisory Team for the Sonoran Desert Conservation Plan, described the County's planning process and the importance of adaptive management. (2) Dr. Bob Steidl, Professor of Wildlife Ecology at the University of Arizona, discussed and defined adaptive management from a biologist's perspective. (3) Paul Fromer, the principal biologist for RECON who is assisting the Science and Technical Advisory Team in forming the biologically preferred alternative discussed adaptive management in light of the Endangered Species Act and the requirements of a Section 10 permit. (4) Steve Barker of the Natural Resource Conservation Service described the role of the agency in providing technical assistance to ranchers in the form of inventories, adaptive management techniques, and monitoring. (5) Mac Donaldson of the Empire Ranch provided the rancher's perspective with a practical description of implementing adaptive management requirements. (6) Dr. Tom Sheridan, Chair of the Ranch Conservation Technical Advisory Team for the Sonoran Desert Conservation Plan, provided the perspective of the Ranch Conservation Team. (7) And finally Dr. Walt Meyer of the Winkelman Natural Resource Conservation District discussed Natural Resource Conservation Districts in Arizona and the partnerships involved in drafting and implementing adaptive management plans for these Conservation Districts.

## III. Conclusion

The Adaptive Management workshop proceedings continue the series that is underway to support the development of the Ranch Conservation Element. On March 8, 2002 another workshop will be held for the community on the topic of mitigation banking.

Attachment



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# Sonoran Desert Conservation Plan



## ADAPTIVE MANAGEMENT WORKSHOP

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## I. Dr. Bill Shaw

Good morning. My name is Bill Shaw and I'm the Chairman of the Science and Technical Advisory Team for the Sonoran Desert Conservation Plan. It's my pleasure to welcome you to today's workshop. This is the second in a series of conservation tools workshop. I believe there will be five separate workshops, all of them intended to help all of us become more aware and have a better understanding of the strategies and tools that are available for implementing the Sonoran Desert Conservation Plan. I'd like to acknowledge the organization of the other workshops by the Arizona Open Land Trust and particularly, the Director of that trust, Diana Freshwater. I'd also like to invite any of you to help yourself to coffee refills, food or whatever it is as we proceed this will be quite informal.

Today's workshop deals with an aspect of the Sonoran Desert Conservation Plan that is really looking down the road. We've spent two years pulling together all the information we can about biological resources, cultural resources, and all the various and massive amounts of information that we've been able to come up with, in order to make it easily accessible and bring it to the table for the planning process. Now we've reached the stage where we will be presenting the draft preferred alternative for the conservation plan from the scientific perspective. We'll move next into the implementation stage which is where all the various stakeholders and interests in the community will struggle with the scientific recommendation and try and make it something that's workable and beneficial to the community. But the process isn't over when that happens, because a good plan should be a dynamic plan and that's really what today's workshop is about.

We know that we have to meet deadlines in order to get a comprehensive land use plan in place rather than wait for all the different types of information that we might like to have. We know that there will continually be more information coming in, new insights, new strategies or perspectives, environmental changes, cultural changes, social and economic changes. All of these changes will have relevance for this plan in two, five, and twenty years down the road, and to me, that is what adaptive management is all about. It's a process. It's adopting a process early on in the plan that will lay out a framework by which we can adjust this plan, learn from our mistakes, learn from our successes and continually adjust and revise the plan to make it relevant five, ten and twenty years from now.

To me that is the simplest idea of adaptive management but it is a concept, one of these terms that has many, many different definitions depending on who you talk to and what discipline they come from. And so what today's workshop will do is present a lot of different perspectives. Adaptive management has a scientific meeting which is quite different from some of the ways that it's used. We'll hear about that and we'll hear about how it's used in the concept of habitat conservation plans. We'll hear about the idea of adaptive management as a mechanism for insuring continued participation by various stakeholders in the process and adjusting it so that it continues to benefit society as much as possible.

So what we have today is kind of a cafeteria of ideas about adaptive management. We hope that we'll look at these ideas and select the approaches that make the most sense to be utilized within the Sonoran Desert Conservation.

We need a mechanism for adjusting it in the future in response to better information and other issues. So with that introduction I will just say a few more words and then we'll move on to our example.

As I said, I don't think there's a whole lot to be gained by arguing over what adaptive management is. It means a lot of different things to different people. We're going to try to present as many of those ideas as possible and my charge to you is think about which of those really have application and relevance to Pima County's Sonoran Desert Conservation Plan.

So, one idea about adaptive management is it's a process of experimenting and proving management strategies. In other words, you try something, learn from it, and do it better the next time. Another idea stresses the incorporation. And yet another aspect by some people's definition, is the monitoring to ensure the degree of compliance with the regulations. For example, we have a piece of paper with the plan and it says, "This is the vision that Pima County has for its Comprehensive Land Use Plan." But are we really abiding by that vision in five, ten and twenty years down the road? It is frequently touted as an approach for bringing new information and new knowledge into the process so that ten years down the road we're not running a County based on the best knowledge we had ten years previous, but instead are incorporating the new knowledge. You see the term also used in describing a process for continually facilitating involvement and participation. Again, so that the plan is responsive to society's needs.

This is what I think is adaptive management. It's a very broad, general definition. As it relates to the Sonoran Desert Conservation Plan, we're trying to develop a process for improving management processes over time, to keep it a living document and a living plan, rather than just a piece of paper.

Today, we're going to hear from a number of different perspectives. These speakers have experience and expertise in various approaches to adaptive management. You are charged today to think about each of these and try to pull out from that, those aspects that make the most sense for implementing the Sonoran Desert Conservation Plan. So with that introduction I'd like to move on to our first speaker.

Our first speaker is Dr. Bob Steidl. Bob is a Professor of wildlife ecology at the University of Arizona with specialties in wildlife ecology and particularly in quantitative aspects of conservation biology.

## **II. Dr. Bob Steidl**

Thanks Bill and good morning. One of the things I do as part of my responsibilities at the University is I teach an introductory ecology class for all our majors in Renewable Natural Resources. I've developed something of a reputation in that class for being a real stickler for terminology and it's not that I think terminology in and of itself is that valuable, but what I do think is valuable is saying what you mean. Students really get the impression from me that if they don't say something just the right way it's not right and that's only because we all understand each other when we say what we mean. What happens in ecology and lots of other areas of science, is that a concept is invented and given a name. Over time, that concept becomes much more amorphous than the original name represented. It's happened constantly in my field and there just countless examples of that. Ecosystem health, habitat, they all mean a whole compilation of things and you really have to ask a person, "What do you mean by that?" Adaptive management is one of those examples.

### **A. Background and Philosophy**

Adaptive management has been around for a long time but in the last ten or fifteen years it has really, as Bill tried to express, come to mean a whole bunch of different things and it becomes much less useful to us when it doesn't have a real solid meaning. What I'm going to try and tell you today is what the original people who developed the principals of adaptive management intended. At least if we're going to call what we're going to do with the Conservation Plan, adaptive management, then hopefully we're going to know what we mean. If we do other things, that's fine. Let's call them something else. Adaptive management is a formalized set of principles that have been developed and that's what I'll talk about today.

It helps me and the rest of us too, since this is more of a workshop instead of lecture, if you ask questions as we go through. Feel free to interrupt and I'll be happy to stop and discuss something if it doesn't make sense or if I'm going too quickly.

This is an outline of my talk today (Attachment 1). What I'll do first is try to represent what I think is the background and philosophy of adaptive management. In some ways, I think that's the most important issue for you guys. You should understand what adaptive management means philosophically. What's the approach? What is it about? Then I'll give you a more strict definition. I'll talk about the actual process of the steps involved in doing adaptive management as have been outlined over the past twenty years or more and then very briefly, assess whether or not it's been working. Since we've been trying to do adaptive management under that name for at least twenty years, in a systematic way, there have been some challenges associated with that. So if we decide to adopt this framework, which I think we will in the Conservation Plan, it's important that we recognize where people have been struggling with implementing this, if we really want to do it, and what we have to do. We need to learn from people who have done it before. And lastly, I'll have some general suggestions.

Before I talk about adaptive management I think it's kind of important to talk about what it's really not. And what it's not is the traditional way in which we have implemented management and policy. There are really three facets that I see that contribute to traditional management approaches and one is conventional wisdom. Conventional wisdom might be your collective experience, a best guess, but really you are sort of flying by the seat of your pants.

The second and another influential set of parameters are political and social concerns that come to bear on the issue. Obviously with the Conservation Plan these are important and strong and have traditionally been involved and influential in the way they affect the management choices that have been done traditionally.

And lastly, with any luck at all, there is some actual information or data to help illustrate what might be the best management approach. One of the things that has become part of my philosophy with the Conservation Plan, is that no matter what we do, it's something of an experiment, be it based on our best guess or our collective argument. What we are doing is an experiment and the conservation plan is going to be a grand experiment. What's important to me is that we build in a process of assessing whether or not it's working and I think adaptive management really does help do that. As I saw Bill put up his slides, one of his definitions for adaptive management is exactly what I think it's not. Isn't that great? So we've been really helpful so far, I can tell.

What it is not, but what it has really come to mean, is not doing a management strategy and then monitoring it to see when it goes sour. That's sort of reactive, but adaptive management is a proactive strategy. It's a way to build in a way to learn as you go about doing a particular practice. It's not saying, "You know, we're going to do something and then we'll figure out ten years down the road if it worked or not." That's not what adaptive management is. That's what monitoring is and monitoring is one piece of adaptive management that's really important. With adaptive management, we can know how we're doing, but it differs from pure monitoring in that it's a much more structured approach.

This idea has been around for a long time. In fact, it was developed in industrial applications in the 1950's in terms of industrial operation theory. That's a fancy way of saying you're in business and you've got several ways to go about doing something. Some of those are going to be efficient, some are not. How do you figure out in a complex way what's working and what's not? And when it's your own money at stake, it's a reasonable thing to do. I would think adaptive management is what we would all do if it was our entity we were trying to learn about and we want to do something that differs from the standard scientific approach. Do we want to learn everything and then make a choice. No way. Adaptive management says we're going to do a bunch of things that seem reasonable and then decide which one seems to be the best approach.

It has been reported through natural resources in the 70's and 80's by two really seminal books and if you are really interested in this I suggest these for you. The first is really a collection, an edited volume by a guy named Holling, called *Adaptive Environmental Assessment and Management*.

Then in the 80's, Carl Walters, who was sort of the guru of adaptive management, wrote *Adaptive Management of Renewable Natural Resources*, and lots of the ideas I'm using today are his ideas.

So first, what is the real philosophy of adaptive management? In a very general way, it is a carefully structured process of learning by doing. It's not learning then doing, it's not doing then learning, it's learning by doing. Learning and doing actually walk hand and hand and they proceed together and that's part of what makes it really valuable. An integral part of adaptive management, and in my opinion it's not adaptive management unless this is part of it, is performing management experiments as research. So if you decide to put in a road through a particular area then you look at that as an opportunity to learn from your management approach. You design an experiment to assess the affects of your road so the next time you put a road in and you want to meet other objectives besides transportation, maybe to minimize the impact on plants or animals or whatever, then you've built in a way to determine how successful you've been at meeting that objective. As a result, the next time you go ahead and do that management objective or prescription, you've gained from your previous approach. As Bill mentioned, another key to adaptive management is that information you've learned is fed back into the policy or management approach that you are using. They become so integrally tied together that information is automatically folded back in.

Historically is we've been enamored with doing management because we want to meet an objective, but we have rarely stood around to see if it's been successful or not. One of my favorite examples is the affects of fire in the Southwestern U.S. and some of the work that I do is fire ecology. We are really enamored. We like setting fires, I'm a pyromaniac, it's great fun. But what we've done is we've set fires traditionally and then moved ahead and prescribed fires somewhere else. Then we're on to the next issue. Because it's expensive to monitor and to see if we've been successful, we really haven't done that. We just want to go to the next challenge. We don't want to see how our management prescription worked and that's really an integral part of this.

### **B. Definition of Adaptive Management**

So here's a hard and fast definition that I borrowed from the British Columbia Forest Service and I've modified it some, but the idea is that it's a process. Adaptive management will continually improve management policies and practices by learning from outcomes of different management programs. All management programs are different things we want to do to the landscape or to anything to gain some particular objective. These management programs are designed experimentally to compare alternate strategies, each of which might be the most successful and to take that information and evaluate what they call alternate hypotheses. That's a fancy way of saying, you know you've got a bunch of ways that might work, which one is best? That's really all a hypotheses is. It means we don't know what the answer is but some of these might work so we try and build in a way to assess which of those seems to be most useful.

I've underlined the word "system" in that last part because where adaptive management really shines is in really complicated situations. Believe me, implementing the Sonoran Desert Conservation Plan is complicated, not just socially or politically or otherwise, but in terms of whether or not it's successful. It is a really complex issue and once you start thinking about it, this is the perfect place for adaptive management. This is where you can't isolate little pieces and learn about those and then make a collection of those smaller experiments to figure out what's going on. It's too complicated to do that so we have to do the experiment as we go about implementing a particular plan and this is what adaptive management is about.

### **C. Steps of Adaptive Management**

So here's a graphical representation of the process itself. It starts in a way that might seem really obvious to most of us but it's remarkable how many fail at the first step, which is asking what's the problem? What's the question? What are our particular objectives? In some ways, without nailing this down in a very explicit way the rest of the process is doomed to failure because we haven't come to an agreement as to what the problem is, or what it is that we're trying to learn.

Once you've decided that, which is a challenge in and of itself, the next step is design. It's recognizing very explicitly a way in which to go about gaining information.

The next step would be implementation, or actually doing the management experiment.

Monitoring is the fourth step. That is, seeing the results of your experiment and evaluating to see how this can be tied back into your policy via adjustment. I'll go through each of these steps right now in a little bit of detail and explain what I think they mean.

#### **Step 1 - Assess the problem**

The first again is to assess the problem. One thing that I think is really valuable for all of us and is also part of growing up, is recognizing what you know and what you don't know and realizing that that's okay. There are things that we all know as individuals and we just know them because of our personal experience, and then there's a whole bunch of other stuff that we think might be true. Distinguishing between those is really critical.

One of the first objectives in this process is to recognize where the uncertainty lies. That is, to know what we know and know what we don't know, and to be up-front and honest and explicit about that. If we want to do a particular objective related to the Conservation Plan, one of the things we won't know is what's the best way to do it? It may be that there are several competing ideas, all of which have merit. Once we've recognized that, then what we have to do is set limits on that process and say: (1) What are our objectives? What is it we want to learn from this management experiment?; and (2) What are the constraints we have? Is money limited? Are the areas where we can do this limited? Are the species so rare that we really can't afford to do a management manipulation on those species?

Since the conservation plan is being built to really try and protect the biodiversity of Pima County, which of those are we going to include in our adaptive management? We can't do them all, and we're going to want to do more than one. Between one and a million is where we have to decide what our limits are and what our constraints are. And then we have to decide over what spatial scale geographically do we want our results to apply? Are we just interested in Pima County? Or just Northwest Tucson? Or Southeast Tucson, or what?

(Question inaudible)

That's going to be part of it. That is, making those hard decisions as to which species do we monitor or which processes do we monitor? And there will be a lot of discussion over that and there will be some information that I think I'll be able to provide to shed some light on that, maybe in particular at another time because that's a whole talk in itself and it's a challenge. In fact, if you look at any of these words too closely and we can be here all day and that's okay. But just know that it's really fairly deep so when you start asking those kinds of questions, which species, that's a challenging question.

Finally, spatial and temporally. We do this management practice or experiment, over what spatial scale do we want it to matter? Over how long a period do we think we want to investigate it?

## **Step 2 - Design**

The first part of this process, in terms of the design part of adaptive management, is building a model. To most of us, me included, model building is a little bit - it's this far in the dictionary from voodoo. But what model building really does is it allows you to stop and think about all the factors that really might contribute to the information that you are learning. Which species, where are they located and what do we know about them historically? First of all you hire a mathematician who does that stuff. The process of building a model is recognizing those components that are going to be important to know about and then going about investigating what we know and what we don't know about each of those components. That's where the value is so far as we're concerned. Later on, Phil Harmon, I think will talk about some model building that he's done in a way that relates to the Conservation Plan. That gets me off the hook.

Again, uncertainty is critical to this process. There will be some things that we understand really well and some that we don't. We have to build that uncertainty in to say, "You know, there are a bunch of things we need to know at really small scales before we can make these large scale management decisions." And then one of the elements that is part of the design process is doing experiments in a way that has proven valuable again and again through time. It's basically using scientific principles of good experiments. There are books and books on it and it's just remembering to incorporate each of these elements that are related to how you do an experiment, to eliminate all the other contributing factors that might come to bear on your issue, and yet still provide reliable information.

These should include controls. If you put in a road, what you should do is monitor simultaneously an area that is similar to that where there is no road, just to try and figure out how it's changed relative to other areas. That's what controls are and we use them in medical research and everything else.

Replication is important. Do it more than once. If you are going to put in one road then there's the opportunity for another road to go in somewhere else. Say, "Hey, you know, we want to sort of build an adaptive management program around that other road so we can see if the results have been consistent."

And lastly, it's using other elements like randomization. If there are a whole bunch of roads going in we can't afford to do them all. Let's monitor at least a few and choose them in a way that eliminates a bias that's not related to what we're trying to learn.

### **Step 3 - Implementation**

Implementation is going out and actually doing the work. To do the work we have to build in a bunch of mechanisms as part of this process so they are integrally linked again. How do we apply the treatment? Who is going to do the work? What way are they going to do the work? Who is going to collect and analyze the information that is going to yield the new data that is going to come to bear in our policy decisions? And mostly, who is going to generate the money to do this stuff? Because it's expensive! No doubt about it. But it's so important that it has to be institutionalized. If we want to learn from our experiments, and the Conservation Plan is an experiment, we have to build in the structure by which to collect this information in a systematic way by having people on salary whose job it is go out and do this to synthesize it and to make it available to folks like us, to see what we've learned from that process.

### **Step 4 - Monitoring**

Monitoring is a whole issue in and of itself. Once we've implemented our design we want to collect information in a reliable way. My definition of monitoring is looking at changes through time, in anything. If you are monitoring for natural resources you are trying to figure out if that resource is changing through time. That's what monitoring is about and in terms of adaptive management, the monitoring not only changes through time but changes due to our management experiments and there are a whole series of questions related to this, which I won't have time to go into.

But, I did happen to put into the slide about which species to monitor, which group of species to monitor and what other natural resources might be relevant. If we're going to think about monitoring some of the species that we haven't recognized, the fifty-six vulnerable species in the plan, which is just one element, we might decide to monitor soil processes instead because we think that is more efficient and those are all good questions for discussion. But if we decide to do species, the vertebrates or invertebrates that we've been thinking about for the last few years, how much do we know about each of those species to begin with? Do we know enough to really go ahead and use them as a target? Which species do we use?

What about the species that are of special concern, like pygmy owls? Do we use those for experiments? Maybe, maybe not. How about species that seem to be indicators for a whole breadth of different species that are relevant? So there is a lot of decisions to make and that's just even just deciding among the species that we have some information on. There are a whole bunch of other parameters that are really of interest as well, so there is a lot of decisions that we need to make as we move this process forward.

#### **Step 5 - Evaluate**

The next step is evaluation, which I think should be obvious because once we've gone about making all those hard decisions, doing our management experiments, correcting information and analyzing it, we then must evaluate it. We evaluate it relative to the initial objectives that we have all decided on collectively. We said: What do we want to learn? A, B, C and D. Now we've got information, so what did we learn about those? Some will be successful, and some might not. But at least we will remember to go back and evaluate what we were starting to do in the first place.

#### **Step 6 - Adjust**

Lastly, we adjust our policy of practice based on the information that we have available. The important part here is the process of updating the information we gained, using it to roll back into the process, so that we get better at doing what we are doing. It's got to be institutionalized. It's got to be just how we do business. You know, we've learned how to do this now or least learned this much more and we have to adjust our future plans to represent or to learn from the information that we have available to us now. Our policies have to be able to reflect this as well. It is in the organic act, if you will. For the way in which we are going to go about doing this, one of the steps has to be that we're going to recognize that this new information is coming in and we're going to adjust our policy accordingly. So this will be a living, breathing process. It has to be because we're going to continue to learn, and remember to incorporate these results into future decisions.

#### **D. Has adaptive management been successful?**

And now a really important question, at least to me when I was starting to think about trying to explain this is adaptive management, which has been around since the 50's. In earnest, it's been around in natural resources for probably twenty years and the amount of adaptive management being done is increasing dramatic. The question is, "Is there anything that we can learn from what people have been doing over twenty years to really help us in our process?" One perspective is that adaptive management has been more influential as an idea than as a practical means of gaining reliable information. So the idea of adaptive management, of learning by doing, has been really useful because we can all understand that, that's how we function anyway, at least when we're older than seventeen.

Anyway, what we do is gain information and we use it to update how we live our lives. We would do the same thing if this was our business and even with a process as complex as the Sonoran Desert.

So, adaptive management really has not been very successful in terms of generating new information, but it has been important as a way to think about learning and incorporating that into policy. One of the critical elements is that you don't start your adaptive management until all of your stakeholders have a chance to contribute to what the objectives are of that particular experiment. What is it we want to learn from the strategy? Until you've agreed on that, the rest of the system is going to fall apart because you haven't agreed on what it is you want to go out and measure.

#### **E. Low success rate for adaptive management**

In general, I would say as a rigorous practice adaptive management has mostly been a failure. As an example, Carl Walters who wrote that book I mentioned in '86 has been involved in twenty-five different broad scale adaptive management programs, probably more than anyone else. Of those, seven actually involved large scale experiments, and eighteen failed before they even started. Seven of those twenty-five actually got to the phase of where they actually put some management practice on the ground to see if it worked. Of those, only two were done in a way that we would consider necessary to provide reliable information. That is, if you use the real experimental design. They didn't go do it in just one spot but they replicated it, they used controls, they used all those elements that are a part of the good sense of doing and collecting scientific information. So, two of twenty-five is not a particularly good track record and the rest just have gone away.

(Inaudible question)

I have no idea. Carl's expertise is in the Pacific Northwest Salmon, he's a fisheries biologist and most of his work has focused on harvesting natural resources. So if you want to harvest salmon for food or for whatever, there are lots of different ways you can go about doing that, lots of different places you can do it, lots of different intensities you can do it with, and lots of different frequencies. So most of his processes have been about harvesting fish.

(Inaudible question)

Thanks. So why has adaptive management had such a low success rate? We asked Carl himself. What's happened, and this doesn't surprise me if you know scientists. They have become enamored of their modeling process, of recognizing the components that influence what's going to happen. You guys have to keep us from doing that because we can do it forever. We could actually. We would love not to take a step forward because we're pretty comfortable not doing anything. Where the challenge is and where the push really has to be, is actually having to synthesize that stuff and move forward. Maeveen, is she here today? Because she's going to push no matter what, despite our digging our nails into the ground, not wanting to move.

Nonetheless, part of the failure that Carl recognized is that a bunch of people are not being able to agree on what's going to be influential in the process in that model building phase. Another is a more dramatic, general resistance to implementing large-scale experiments because they are seen as too risky or too expensive, but guess what?

Doing nothing is an experiment. Choosing to do nothing is choosing to do something. So what people have to realize is that, "Yep, to do this process right it's going to cost money," just like everything. No surprise there, but if we really want to go ahead and learn and move forward, we're going to have to do things that we might be a little bit uncomfortable with because not doing something may be the worst strategy. We'll never know unless we go ahead and implement something on the ground, in the best way we know how. And no surprise to anyone else, there's been huge resistance to a bunch of these processes by people and their own self interests.

One of the interesting things that Carl points out that surprises me, is that there were conflicts of values within the community of interests. People who are interested in the ecology of a place and the environmental management of a place, and who are seen as really being on the same side of the fence, are arguing so intensely that nothing ever happens. It's those people who are the interested public or other people who just have an interest in that place, in and of itself, and its ecological value, who have been struggling with the people who have to manage that land. And it's not from developers or people who want to put a huge pit mine in a place, that's not really where the conflict has been. It's been among people who really are close to each other and their values. And that has been one of the major sources of consternation at failure for adaptive management. So I think that speaks to the need to find common ground reasonably quickly. I don't know how you do that, but it seems to be really important if we want to move forward with this process.

#### **F. Conclusion**

And then finally, we asked the question. Adaptive management, in it's strict sense, really implies those management experiments. If we're not doing those experiments, we're not doing adaptive management and that's okay. We can choose not to.

Do I think adaptive management is going to work within the Conservation Plan? I think it would be criminal not to move forward with it.

Do I think it's going to apply everywhere? No! I think we will have a real strong element of biological monitoring here as well, but I think when the opportunity exists to look at management manipulations as experiments, it would be criminal not to go ahead and do that and to learn. Again, it's just how we would function in our own lives and to not do it and build it into the process of implementing the conservation plan to me would be a real mistake.

I think we have a goal for the Plan as an experiment. What we want to do is make sure and keep all the parts. That's really what we're after. And resilience, what that is in terms of ecosystems is what we've done is leave the thing in place so it can respond to a catastrophe. So if something drastic changes, climate change or who knows what, that system is still maintaining its integrity so that it can recover no matter what's being done to it. We've built in the ability or we've left it alone to a degree or managed it to a degree where the ability to be resilient to those pressures still exists. You know, we can argue about the details of what that really means, but if we do this then we've been successful. It sort of reminds me of the Hippocratic oath really, first do no harm.

We have to maintain a realistic time frame. This takes a long time. Just to give you some perspective, the people who have talked about monitoring animals, vertebrate animals, have said that it's a minimum of ten years before you can get information that's going to tell you whether or not that population is increasing or decreasing. It just takes a long time and that's how it is. We're looking at buying off into a process that's going to take years and years and years. Humans, at least most humans, unless you are a geologist or something, think about limits of a generation. We can really understand what a generation is, but once we start getting back further than twenty or thirty years it really doesn't make a lot of sense to us.

Have realistic objectives. We can't do everything, but we can do some things so let's choose carefully what it is we decide to do and do it well. And what's going to limit that to some degree is the available resources. Look at all the money we have to do this stuff. Another suggestion is have plenty of available resources so you can actually go about doing what you want to do. You are not constrained in some way by something that seems almost arbitrary. It seems to me that answering some of the questions that we'll have to ask at a big scale, will require a commitment of resources that's necessary to learn in that way.

Lastly, those of us in Pima County probably know the resources here the best, but what we may not have is the broadest perspective on a lot of decisions that we have to make about which species to choose, and how long should we do this? How risky can it get in terms of those decisions? And that's where we need to get help from people. We all sit down and collectively decide on a bunch of things we want to do and how we're going to do it and then we put that out there say to people, "What do you think?" and we outline what our alternatives are. You say, "You know, we made a decision here to go with this species instead of this one because of this reason." Does that seem to make sense to you? It made sense to us. The seeking of outside review really lets the whole process stand up by itself and that's, I think, what we're going to shoot for? Any questions?

QUESTION: It sounds like an ideal management strategy...(Inaudible)

See? Thanks. The question really was: Is this a panacea that we could never meet? And I would say, in general, I think if we don't try and meet it then we've failed before we've started. We're doing experiments all the time, but what adaptive management really is, is building in a way in which we learn from those in an efficient way. Yes, it's expensive, but it's not that expensive relative to the cost of making mistakes, which I think has an infinite price tag. We can't afford to let those pieces fall if we have other options. This is our option, so let's do what we need to do now to make sure that it happens.

AUDIENCE:

Yes, I have a talk on every one of those bullets so I have a bunch of information.

AUDIENCE: .....and we're very foolish if we don't. I keep hearing from you, we've got to set up an institution....

I would agree completely and maybe I wasn't clear but the portions that I want to institutionalize is the money and the positions maybe, by which to go about and collect biological information. That's what has typically failed in the past and it has nothing to do with private land or public land or whatever. It is what we decide to do and I don't know what that means, a particular management manipulation, then we go ahead and do that manipulation because that's what's going to be done. But, what we've built in is the money to figure out if it's worked or not. So by institutionalizing, I'm not saying or insisting that anyone does this, but I'm saying that if there's going to be some particular manipulation on the ground, whatever that is, we have to have the money available to go there and measure the response of that particular management strategy. So the last thing I want to do is to create another agency, but what I wanted to do....

AUDIENCE: .....land with my permission or is it (inaudible)

I don't think anything that we would do would even remotely want to impact your private land at all. In fact, I suspect that most of the adaptive management that would be done in the way I'm talking about would be on public land. That would be my guess. All I'm talking about is a way to collect information and have money to do that, so the burden is not passed onto anyone else.

AUDIENCE: inaudible

Yes. One of the things that we could talk about and we're on the same page so don't you worry, is the issue of causation. To show causation, to say A caused B, or to say that the weather caused a decline or a particular management practice caused decline, requires that we do manipulations; some experimental manipulation occurs. That is why for years the tobacco industry would never say that smoking caused cancer because there was no manipulative experiment. They didn't randomly take one hundred babies and make half of them smoke, that would have done it, of course. That's not within the limits of reason and ethics, but that's why they wouldn't say it because showing causality is a major challenge and the only mechanism we have scientifically to show causality is with randomized experiments. So by incorporating some of those elements I mentioned, I was speaking to higher level information. Information that is credible, reliable, valuable and when possible is getting at cause. A caused B, not just an association between weather and tortoises and whatever, but we've set up experiments in such a way that we have a very powerful statement when we're done, so that's part of the structure that I think I'm here and fighting for.

AUDIENCE: inaudible.

Yes, it's a good question, and basically there is sometimes going to be long time lags. One of the things you can do to try and reduce a time lag is design efficient experiments. There are other contributing factors that is going to affect the information we get. Weather is a perfect example, especially here where it's all over the place. This place is a mess in terms of weather. So what we try to do is design an experiment in such a way that takes advantage of that variation or does it in a way that restricts the variation in which we look at.

So we wind up not generating the grand answer to everything, but we have small pieces that we have faith in and that would give us insight to that larger picture. The other thing that I would speak to is the alternative of saying, "You know, it's going to be twenty years before we have good information and so we have the option of doing nothing". If people had started doing this twenty years ago, I think we would all be sitting in a much better place so I think the onus is on us, despite how much money it's going to cost or how long it's going to take. We owe it to the people we're planning for in the future, to start now.

**Dr. Bill Shaw**

Thank you Bob. As I said in the introductory comments, we're going to present a spectrum of different perspectives toward adaptive management. What we asked Bob to do was take the academic approach and tell us what it means in a purely scientific and academic sense and that's what he's done. In addition, he acknowledged, and I will acknowledge, that those of us from the ivory towers have come to recognize the fact that we're not going to be in total control of this process and have unlimited budgets to do all that we want. But we are committed to the bigger idea of doing the best plan we can and making that plan a responsive document as we get smarter and as we learn more down the road.

So when we, we meaning the Science and Technical Advisory Team, which is a group of biologists and volunteers, began to try and figure out how to address this daunting task of biological input for a Comprehensive Land Use Plan, we needed to find someone who could bring to bear the full-time expertise.

We were volunteers with a wealth of experience and in a sense it relates to what we've said. We wanted to learn from the other grand experiments of which there have been a number of multi-species habitat conservation plans.

But we didn't just want to plug in a formula or a process that worked somewhere else without learning what worked and what didn't work. The way to do that was to find somebody who had a broad range of expertise with these plans but also had an open mind to try and adapt this planning process to Pima County's needs, and our next speaker is our solution to that.

We put out a request for proposals and selected a biological consulting firm that had both a wealth of experience in conducting habitat conservation plans, but also indicated this desire to learn from those previous experiments and make Pima County's the best one to date.

So our next speaker will take it from academia to the real world and discuss adaptive management as applied in habitat conservation plans. Paul Fromer is the principal biologist for RECON. RECON Environmental which is the environmental consulting firm that's been hired to advise us and gather the materials that we're using for this plan.

### **III. Paul Fromer** (See Attachment 3)

#### **A. Legal/regulatory sources**

I'll talk about where adaptive management ideas generated to where they are today within the services and thoughts about what is necessary for HCP's (habitat conservation plans). I'll talk about the U.S. Fish and Wildlife Service handbook, which was published in 1996 based on revisions to an earlier draft from the early 90's, and then talk about the more recent 2000 five points policy which clarifies and I think gives a lot more guidance as to how to use that and other things in the process of developing habitat conservation plans. Finally, just a couple of observations about precedents that we hopefully can use and things that we can learn from other planning processes.

Hopefully you've all seen this one hundred times but I just thought I would just throw this up on the board. First, the list of components that need to be within a habitat conservation plan and then the criteria that the service essentially has to follow or evaluate when they are evaluating a proposed HCP. Now, just to back up, I really want to emphasize that what I'm talking about right now is the Section 10(a) Permit aspect of the Sonoran Desert Conservation Plan. The plan itself is much bigger and we're trying to accomplish much more than is necessary for fifty-six species in a habitat conservation planning process with the Sonoran Desert Conservation Plan. What we're really trying to do is something philosophical, that is conserve our natural heritage, our biological heritage, within Pima County, not only for us but for our children and grandchildren, everyone. And so that's a really important aspect and that takes in more than biology. That takes in ways of life and all of the other activities that humans and everything else, every other resource in Pima County, has. That's the context, the bigger context.

#### **B. The Law: Endangered Species Act (ESA) and Section 10(a)**

What I'm going to talk about now is much more focused on that portion of this planning process which would result in a 10(a) Permit under Section 10 of the Endangered Species Act. And, in that section of the act there are certain criteria and things that need to be dealt with. Nowhere in the act itself does it really say anything at all about adaptive management so that's a concept. The act itself is from the 60's-70's and these ideas had not been fully developed, even though they were in the biological community and elsewhere. They hadn't been applied to individual species, although not in name but in fact, they have been now at one level or another.

##### **1. What the Conservation Plan must specify:**

Two things are really important: the steps that the applicant will take to minimize and mitigate. As Bob said, each one of these words we can examine in great detail. Attorney's have examined all of these words in great detail but we as biologists look at it in a different way and I'm going to come back to this theme and I think it's really an important one. Uncertainty sort of guides all the things that we do and there is a lot of uncertainty as to what these mean. There are only these things to do to develop a habitat conservation plan.

The wording in the act itself is not much more than this. There are more legal terms in there. The concepts are very simple, but applying concepts to reality, and in particular, the difficult job the Fish and Wildlife Service has of actually taking a habitat conservation plan and saying whether or not it includes these things or meets these things, is very difficult. In fact, that is one of the major focuses of the development of adaptive management plans, is to reduce uncertainty and so we'll get to that. And then there's adaptive management plan policy, as opposed to law, which has been developed over the last few years. This is any other measures the secretary would deem necessary to implement these. These other measures are what were directed to the service to develop a set of policies which resulted in the handbook and other policies.

## **2. What the Conservation Plan must ensure:**

This is sort of a parallel thing but this is what the secretary must ensure that the HCP has. This is the process that they have to go through to approve the plan and it must meet all of these criteria. Something as simple as I said before, the minimization and mitigation. Well, how do you measure that?

How do you really determine not only at the beginning of the plan, but through the life of the plan whether or not that, in fact, has actually occurred. There is no language in the act which really directs us as to how that's done. It's a simple concept and yet we don't have a lot of guidance, especially from the beginning of the 10A Permit process.

Also, one of the criteria is that the Plan must ensure is that a taking will not appreciably reduce the survival and recovery in the wild. Here, we are talking about those fifty-six species. So technically, if were going to do a multi-species plan and we followed that to sort of the letter of what you understand is the intent, we'd have to have a monitoring program for all fifty-six species which we know we can't afford to do. It won't happen that way.

The first HCP's were all single species plans, for a few species at most. We're able to sort of get their arms around viewing with a lack of information for one or a couple of species. We're going to have to be looking for innovative ways to deal with monitoring the requirements of those fifty-six species, much less all of the other resources that we really want to fold into our adaptive management program. So that's sort of the background from a legislative standpoint, that's all the law that we have.

## **C. Policy: USFWS Policy Guidance for Adaptive Management**

The rest of what we deal with in adaptive management programs is policy. Policy guidance really comes in two primary forms, although there are lots and lots of other smaller executive orders that would deal with this. I think these two embody most of what we will need to try to achieve to demonstrate to the Fish and Wildlife Service that our HCP, the part of our application for the 10A Permit is, in fact, adequate by their standards.

## **1. Endangered Species Habitat Conservation Planning Handbook:**

So the first I will talk about is the Endangered Species Habitat Conservation Planning handbook. November 1996 was the final draft. It was out in earlier draft version for a number of years and this version incorporates lots and lots of comments that were received during the draft stage of that document. What I'm going to talk about is just essentially an outline of their adaptive management discussion within the plan and actually I think they give very good philosophical guidance as to what an HCP would need to include if they are going to incorporate adaptive management, which large regional scale HCP's are strongly encouraged to do in HCP policy.

So these are the major areas:

- Purpose
- Conservation Strategy
- The role of research
- The role of monitoring
- Initial assumptions
- Corrective actions

They are all very logical and they fit into place. I think they fit very much what Bob was saying, but they are all very broad and general in their outline, so I'll go through them just really briefly and maybe make a few comments about each one.

**Purpose** - As stated, this really is the purpose of adaptive management within the HCP planning process and I think this is really key and it has to do again, with uncertainty and we know that we don't know a lot. I mean, for any of the species that we're talking about, some of them are very rare and some of them have not been the focus of research interest. Therefore, we don't have a lot of information, either about the species themselves, or there just isn't a body of scientific data or the basic biological requirements of those individual species. So, an adaptive management plan must be put in place in a plan where the information is not adequate to make initial decisions about required management. It's a risk that's being taken on the part of the Service, if the Service has agreed that if it is a viable and appropriate adaptive management plan, they can approve a 10A Permit, even with what would be less than adequate data to really resolve whether or not we can manage those species in the future. The promise is to do a valid and appropriate adaptive management program in exchange for spending the money that's required for a permit now. That's sort of the benefit of that trade-off.

**Conservation strategy** - The conservation strategy that it is part of and that we're supposed to develop includes defining biological objectives and goals. Goals are really broad, over-reaching, over-arching things that you would like to accomplish with the management plan and then the objectives are much more measurable. I think we will get into that in much greater detail as we move forward, but we are treading new territory with these kinds of things each time we develop a habitat conservation plan.

Modeling is part of the conservation strategy. It is mentioned very specifically in terms of modeling ecological systems, it's components, the interactions among the different components, and then trying to also model natural fluctuations and include and incorporate that into the process. Again, these are all fairly general discussions and they all make sense when you read them. The difficulty comes in translating them to an actual adaptive management program on the ground.

Allowing for changes in management is also part of the conservation strategy. We must allow for changes based on the information that is collected through measuring those goals and objectives. Ultimately, this is a requirement that we have to meet for the specifications of the act. One of our goals is to ensure the likelihood of the survival and recovery of the species in the wild, which in this case would be those fifty-six species that we're asking to be covered. In reality, it will be those species for which we actually get coverage because of the quality and comprehensiveness of our plan.

Role of Research - Now the role of research is also highlighted here and this is one that I think will be the focus of a lot of what we're going to be talking about. However, the way it's discussed here, it's obviously to fill in the co-gaps in the existing information, of which large gaps exist for some species, and much smaller gaps for others.

Testing the effectiveness of management, specifically in a scientific way, is also part of the role of research. This has to do with the right means for assessing whether or not minimization and mitigation have occurred. This is really a tool for the Fish and Wildlife Service to use, to justify their action to approve or not approve the permit, based on what was incorporated in the adaptive management plan.

They also have a broader goal of producing better ecological knowledge, which I think is further clarified a little bit later on, not just for the habitat conservation plan itself, but for those species or resources which are included in the plan. That's a much broader goal than just the survival of the individual species in the wild. Developing appropriate modifications is another goal and that is fairly obvious. Change the plan when it needs to be changed to better address the goals and objectives of the habitat conservation plan.

Role of Monitoring - The role of monitoring as it is outlined in the manual is to first ensure proper data collection, analysis and use. What "proper" is, is something that we really need to focus on ourselves. Again, these are all very logical but they do not come with a lot of guidance as to how to carry them out. Understand these things is very clear, but what our challenge is, is to translate what we're going to do on the ground.

Part of monitoring is establishing a testable hypotheses. Again, that is what Bob said and there were a couple of comments here. This is really key and the service recognizes that. Their focus is on the hypotheses, which link the conservation strategies and the management that goes on with the conservation strategies, and specifically on the biological goals and objectives that we have developed in the planning process.

Another part of monitoring is defining specific thresholds. These thresholds have to do with the individual species, looking at either linked, very key criteria that we have predefined, or very specifically, with measurable criteria. Measurable criteria is something that they emphasize without going into a lot of detail as to how you go about measuring, but measurable criteria is something that we all will be looking for.

Initial assumptions - This is the point in time where we, the Service, and all of the participants form our hypotheses. The initial assumptions are very, very important because we have to come up with these before we've even done some of the pilot programs that we might like to do. We're going to have to guess to form these hypotheses about the initial management requirements that we're going to test in the future. And, as was discussed at the end of Bob's question and answer, we're talking about maybe ten years worth or twenty years worth of data collection based on our initial assumptions before some of these will actually produce measurable results in a statistically significant way. So it's very important that we develop our initial assumptions very carefully and we have to first have an agreement as to the potential range of adjustments that might be made.

It's a legal requirement to have agreement as to the range of potential adjustments. It falls into the no surprises policy that will be a legal part of the document for the habitat conservation plan. This defines what the County and all the participants are required to deal with. Things that would be outside of that, would be things that the federal government must deal with.

Mechanisms to determine the magnitude of the adjustments are also very important elements of the initial assumptions. How do we go about changing management once we've established it, especially if there are substantive changes that would have effects on parties outside of the natural areas? This is definitely where a ranch community that is participating in the program, would want to know if the way they are managing in a voluntary and cooperative way, isn't working. Well, what can they be required to do in the future to address aspects of the management that might not be working? So we have to define that very carefully in a way that is compatible with all the needs, not just the biological needs.

Obviously, these must all be based on monitoring, and again the monitoring is the critical baseline and there are lots of assumptions that go into what it is we need to monitor to begin with. That means we have to make a very good guess as to the variables that are important for the resources that we're going to be monitoring. All of this must be developed in advance and that's the really difficult part, from our perspective, having the mechanisms and processes in place for the plan and the 10A Permit process.

Corrective Actions - Corrective actions are fairly straightforward. They must be based on significant, non-achievement mitigation. The word significant has so many different meanings and not just statistically significant. So that's one that we will want to develop a very good definition for as we go forward. From our plan process, what is significant enough to require changes in management actions?

And then there's a commitment from the Fish and Wildlife Service to work with the applicant, specifically to compensate for external factors. Global warming, for example, would be something that we would definitely need to work with over the thirty, fifty year term of this plan. That's a very important element that we cannot predict at this point. It means developing a strategy and the strategy and may include voluntary increases in the baseline mitigation. But these would be voluntary because these are things that the Service would be asking for, to make up for changes that could not possibly be foreseen at the beginning of the planning process.

## **2. Addendum to the HCP Handbook: the 5 point policy**

The next element I'd like to talk about is a clarification to this adaptive management section, actually to the manual itself that was published in 2000. It was called *The Five Points Policy* and here are the five points:

- Biological goals
- Adaptive management
- Monitoring
- Permit duration
- Public participation

Not all of them focus on adaptive management and adaptive management is one of the specific points. But the first four are all very interlinked with adaptive management. What I think this was trying to recognize was the need to reinforce the need to do adaptive management and to further integrate it all and tie it in to the development of habitat conservation plans.

Biological goals - The first discussion is biological goals and objectives. The words were said in the manual originally but were vague and without much guidance. There is more guidance provided now in the manual but it still doesn't tell us how to do it. It does however tell us more about what it needs to look like, which I think is good. Part of the problem is that with the development of adaptive management plans, it has been very difficult over the last twenty years or so, to synthesize those and bring them all together.

This is because we have lots of good theory and broad-based discussions, and then we have some specific applications. It's that in between taking of specific applications and figuring out how those best could be generalized; a guide book about how you take the broader goals and really implement them in a more direct fashion. We don't have that guidance at this point in time. I'm hoping that this process will result in that kind of general discussion of how you really apply these.

I won't read through all these but what they really are doing is trying to tie all of the elements of the HCP together in developing specific goals and objectives. Those can then be incorporated into the adaptive management plan.

Adaptive management - Again, the stress is on addressing uncertainty, which is inherent in all of these biological planning processes, not only because of the lack of data, but because of the lack of uncertainty in biological systems and processes themselves. We still don't have all of the tools as we might in a manufacturing process to look and measure and predefine what variability might occur. We are always surprised by biological resources, biological systems and that's why many of us become biologists, just because that's the front part of all of what we do.

In addition, adaptive management must be, and this is very forcefully stated, used to examine alternative strategies to meeting the biological goals rather than just testing the hypotheses.

Monitoring - Monitoring is also stressed and it's focused back on providing assurances. The real key component that we have to address is compliance. Is the 10A Permit and all of its terms being complied with by the applicant and all the participants? That's the legal side of compliance monitoring. What we are really focusing on here is not the legal side, but the monitoring for biological resources and the performance of the plan. You can be sure that compliance itself will be a very large topic in the more public aspects of the development of the plan and what is agreed to and what is not agreed to. But, that's not what we want to focus on.

Assisting and redefining the biological goals and objectives is another really important element that's adaptive in and of itself. We establish biological goals at the beginning of the process, but those are going to change with time. As we learn more, we need to refine those and we need to incorporate a process for refining those as we move forward. Then finally, in a much broader sense, the service would like for these programs to provide data that's valuable for a range-wide assessment, as well as in a form that's compatible and consistent with other actions, research plans, and their own work that's going on.

Guidelines for monitoring program characteristics are also given. Flexible is a characteristic that is fairly obvious because of the scale on time. Comparable, spatially and temporally, just means that our plan needs to fit into work that is going on within the Sonoran Desert, so that the data that we provide can be used for the Service and for everyone else, to get a bigger picture of what's going on range-wide. This also enables us to compare and contrast data over time and within the entire range of the species. And based on sound science and standard survey protocols, to the extent that those might exist, is again just reinforcing the need for that.

Permit duration - Permit duration is not really an adaptive management plan issue except to the extent that we're talking about adaptive managing requiring ten or twenty years to really kick in and be valuable in first assessing change and then starting to address change. A permit that only goes five years, which proposes a twenty year adaptive management program, really doesn't make a whole lot of sense. Because we're talking about longer term processes that we need to be measuring, clearly the permit needs to be commensurate with that. Not to say that it won't be revisited periodically along the way but that has some affect on adaptive management.

The duration of the permit, in the terms of the way the Service evaluates it, will be evaluated as to whether or not it has an appropriate and a feasible adaptive management program. So if it doesn't, then they won't approve a permit for a very long period of time. With a well-developed adaptive management program permit, no longer permit time is permissible from their perspective.

### **3. Precedents**

Finally, I just want to talk a little bit about precedents. The development of HCP's has been pretty dramatic. There was a lot of discussion on adaptive management in the early 90's although no guidance in reality. There was much less literature available than is available now, and we were just sort of guessing and moving along. The basic understanding that we who were working on these kinds of plans had, was that it was a way to incorporate hypotheses testing into the management process. In other words, make it a little bit more rigorous so that we weren't just guessing and then modifying as we went along. That works pretty well, but not well enough when you only have one shot at managing the species. This is a one time experiment and if the experiment fails and you haven't designed your monitoring and experimental questions correctly, well the failure is extinction of the species, and that's something we definitely want to avoid.

Another thing I think is really valuable is that both the manual in 1996 and the five points in the year 2000 have been the Service's intent to embody all of what's been learned in the HCP process throughout the United States during that period of time. And I think they've done a very good job and it's very well worth our taking a look carefully at those because they provide a lot of information. Again, the bottom line in my perspective is they tell us what we need to do, but they definitely do not tell us in Pima County how to do it. There are lots of models that will be valuable in informing us as we move along, but they aren't directly applicable at this point in time for what we're doing. In particular, I think the science here may be easier in some ways than the process, which will be a much more political or something that hopefully will be developed in conjunction with many of you here. We need to achieve not only our biological goals and objectives but include it in adaptive management and include it with all the other goals and objectives that we want to accomplish with the Sonoran Desert Conservation Plan.

The last element is that all of this has to fold into the political, biological, and economic reality that we have to develop this plan in. Those are all components that need to be addressed in the 10A process and the amount of documentation that go along with it. That's my dry discussion of the legal and policy aspects of adaptive management.

AUDIENCE: inaudible

Well, it really doesn't cancel out. It is an admonition to the Service that they should continually be involved in the process. If there are adverse things that are going on, they can work with the plan sponsors and all of the other participants to address those. They are admonished to try to work with them in a voluntary way, but they cannot coerce or force them to go beyond what is defined in the no surprises policy. The way I like to interpret it is

that the Service has to be engaged and evolved in the plan and in the adaptive management program, so that they are working closely with the implementers of the plan to ensure that all of those things can be added to improve the probability of success of the outcome.

AUDIENCE: inaudible

Right, but it's voluntary. It really is voluntary.

AUDIENCE: inaudible.

Well I think in part we've been doing that over the last six months. We've been collecting all of the management policies, guidelines, and management planning information that we can and we're continuing to, so that we can use that information as baseline information for the adaptive management program. To the extent that we can take a look at, call it a natural experiment because that's what we normally say, what's out there and see if you can actually reduce the variables to measurable variables between the different treatments that have occurred by circumstance. I think we want to do that and that's one of the things that we will move forward in doing. We really haven't jumped into the analysis part yet because we're looking specifically at compiling all of the management policies. But to a certain extent, it's not as simple as it might seem because again, we have to be able to define appropriate variables and sometimes you don't have appropriate control. There may not be enough examples to look at, but we are going to at least take the lessons that can be learned in a general sense. You don't have to do statistics to know that in certain measurements, which you can look by eye, this one is doing better than this one just because there is less erosion or something like that. You can compare the management processes and that at least starts to help you develop appropriate hypotheses for management to use then in the adaptive management program. That we will be doing extensively over the next couple of years in particular.

AUDIENCE: inaudible

That's a good question and I would like to say that although adaptive management programs are part of HCP's in many areas, we don't know whether or not they are successful. They haven't been in place long enough for us to really judge the overall long term success. I think the success so far has been measured in whether or not we got them up and running and implemented. But in terms of its institutionalizing them, Clark County is a good example of a recent multi-species plan where the County itself decided that adaptive management in the HCP was a large task. So the plan would be approved, they made the development of a full adaptive management plan one of the implementation aspects of that plan. They also provided specific funding and contracted with the University of Nevada at Reno to develop the long term adaptive management plan. Meanwhile, there were already interim measures that were being implemented under the direction of their implementation and monitoring committee.

So that's the structure we're going to be working on, although we want to be a little more forward with the adaptive management plan and we've got a lot of resources here that we can apply. In terms of institutionalizing, there are a number of different models that we can use. One of the things I think we all want to do is to make sure that it's the best scientifically driven process, and at the same time, that it incorporates the concerns and needs of the human citizens of the County. So those two things are going to be key elements in the adaptive management program and how we mesh them is going to hopefully be part of the result.

**Dr. Bill Shaw** -- I'm not sure what you're after Tom. There are really two steps here. One is getting the money to do the stuff and the other is what you do when you have the money. Since Paul has been so involved with Clark County, what we're doing honestly is looking at that and saying how is that working? Where can we improve on it? We've already had discussions about failures or the lack of perfect success in their process, and how we might do it slightly different once the money has been allocated. How do we do this in a way that gives us the most bang for the bucks or the most information for the bucks? So, we're using those as examples of what to do and what not to do.

AUDIENCE: Oh, we're rich!

No, and that's true and I think we want to make this as effective and efficient and efficacious as possible. We want to spend the money necessary but not more than we need. Unfortunately, again, we have plenty of negative examples to work from, but we don't have the how-to model that exactly applies to Pima County. We're going to have to be innovative and creative and do this, but we have a lot of tools to work with.

AUDIENCE: When you talk about the (inaudible)

Well, these don't come from those same pools. I mean, these are all different goals. We have multiple goals and objectives here as we do elsewhere as to what's appropriate and necessary for us to do. I would object to you saying we don't use good science. First off, the act itself says that we must use the best available scientific and commercial data and that's what we are doing. In particular, the act itself recognizes that there will always be uncertainty with endangered species and rare resources. We can't have scientifically valid, statistical inferences on every single aspect of all of the species. It's just not possible. Sample sizes for some species are too small and so they just cannot be done. But nonetheless, we have a substantial amount of biological information and there have been comments from the scientific side saying we're woefully inadequate in terms of the information. Well we are if we're trying to publish a paper in science at the 95 percent confidence level, but we're not that far below that level. It's just that no scientist would say, "Well, you can say with 99.9% certainty,". But we're talking about 80-90%. Even though we can't say statistically valid data, this is statistically valid at that level. It's clearly enough for us to make management decisions if the alternative is to just say, "Well, we don't know anything." That's just not true. We know lots and there is lots and lots of information and we need to move forward with the inferences that we can make from good data that we have.

**Dr. Bob Steidl** -- Yes, two things. First, I would say that every step that we have done has used the best available scientific information and to say otherwise, to me, indicates that you don't really know the process that we've gone through. I have no stake in this except that I live here and I'm concerned that it comes out and does use the best available information. So I see myself and others on that plan ensuring that that's happening.

The other thing you mentioned was peer review. There have been at least fifty outside reviewers involved in this process every step of the way. Now not every one of those is advertised in the newspaper, but for every one of the vulnerable species that we have of interest, we have sought outside experts to say, "Do you think this is a reasonable way to move forward on this?" So, it has been steeped in what I would call the best scientific information that we have available. It's not complete information but it's the best that is there and the peer review process has been constant. It's constant and we are the one's who want that. We want to make sure that the steps that we take are based on the best information. The information we have is being validated outside of us and we use their suggestions and are constantly folding those back in. That's really been a part of this process.

**AUDIENCE:** ...presentation though that's available scientific.....

You know biologists. We're poor. So to what might not seem like a lot of money to some folks, is a lot of money to us. So to do a research project, if it costs us \$50,000, that's a lot of money but it's small potatoes relative to a lot of other things. Just so you know, when I think about a lot of money it's probably not \$115 million, it might be \$250,000. Just know that my perspective is biasing the way in which I am presenting this. So for us to do it, we need a certain amount of money. I don't know how much that is, but how much money we have available will dictate what species we can monitor. In addition, we will meet and collectively seek outside review to decide what is the most efficient way to do that. And we've built models for all of these species as, and models as we know are experiments in and of themselves, to see which variables are most influential.

**AUDIENCE:** inaudible

That's a question that is coming up increasingly as people are experiencing some angst in this process because it's taking awhile. Let me say that our task as the Science and Technical Advisory team is simply to present the best biological alternative, but the Sonoran Desert Conservation Plan is much more than biological. It's first step was to synthesize all the information, so that we can put forward a defensible, best biological alternative and that's what we're doing. Biologists alone aren't going to design the Sonoran Desert Conservation Plan. That's just the foundation of it because that's what mandated, under the law, to get relief from the Endangered Species Act through Section 10. Now it will enter the arena with the steering committee where all of these other stakeholders and issues become involved. So you are only seeing, when you refer to that map, the biologically preferred alternative. We put that forward and are prepared to defend that as being both the best information and the best science related to biology and that has been our task, to oversee that process. But now that it's in the political arena, there are a lot of other issues.

There's cultural heritage, ranch conservation, economics, and a host of other issues that have to be integrated by Pima County.

AUDIENCE QUESTION: inaudible

Well, we develop a Comprehensive Land Plan for 9,000 square miles. It includes private property, public property, and a host of everything else. We're looking at the big picture, not at individual property. Our task is to look at the big picture.

AUDIENCE QUESTION: inaudible

Square miles.

AUDIENCE QUESTION: inaudible

I couldn't agree more and that's why we're now into this series of public meetings and involvement of the steering committee, to address those kinds of issues. But I'm no more of an expert on your particular interests and my particular interests and anybody else's. What we are as the Science Technical Advisory Team, are experts on accomplishing the biological objectives of the Sonoran Desert Conservation Plan, which are only part of it so you know. I don't disagree with what you are saying. We're not going to go out and do individual studies of every parcel. We can't and that's not the scale of planning that we're trying to do. It wouldn't even be appropriate.

We have a simple mission which is to present a plan that will ensure the perpetuity of the indigenous species within Pima County, first and foremost. That's not speaking of the Scientific and Technical Advisory team. The Sonoran Desert Conservation Plan is bigger than that and it's got to consider economics and all the individuals. We're going to have lots more time to discuss some of these issues and I invite this kind of dialogue because we need it. You will see as we progress that we're going to move from academia, and now we've heard some of the regulatory perspectives and compliance perspectives with regard to adaptive management. Now we're going to hear from some people that manage land, some people that are on the ground. Every day is an adaptive management experiment if you are trying to survive and make a living off the land in Arizona. So we're going to, again, shift and get even more practical as we move ahead.

What I want you to do is listen to these talks and look for examples of opportunities where they have mechanisms for being responsive to what they learned from their experience in managing land and resources, and adapting their management in response to those. So, our first speaker is Steve Parker. He's with the Natural Resource Conservation Service and he's been involved in range management for Arizona for the past twenty years. He is the State Range Specialist and he's going to describe some of his activities in facilitating partnerships. Because one thing we do know for sure, is that no individual entity or no individual institution or organization is going to pull off the Sonoran Desert Conservation Plan. We need a cooperation and we need coalitions, and with that, I will introduce Steve Parker.

#### **IV. Steve Parker**

Thank you. I appreciate being invited to come give this talk.

The NRCS, for those of you who don't know us, is a federal agency in the Department of Agriculture and we work primarily with private landowners. We were set up in the dust bowl days when the Midwest was blowing away. It is kind of a federal consulting agency to private landowners and that's what we do.

I want to talk to you about what you would call a model, today. I didn't know this was a model until a couple of years ago. It's a model for successful land management that we've been playing with for the last fifty or sixty years, and at least forty of those here in Arizona.

The model that we play with is called Arizona Ranching. It's a model about people who harvest products off the land while protecting the environment and maintaining open space. That's been our goal. We've learned that properly managed range and livestock production is a sustainable form of agriculture. It produces food and income for people and it maintains its uses and values of lands. But it's the economic benefit of livestock production that provides that income and lifestyle that keeps people out there on the land and managing the land, and that's an important thing to remember. It also reduces the pressure that we feel to buy up, subdivide and develop the land. If there's not an economic incentive for somebody to stay out there and maintain open space, then there are other incentives to do something else with that land.

When we manage our range lands, based on good science and based on a lot of experience, then livestock production is a sustainable land use and we can harvest a product. In modern grazing management, it involves ranchers who are out there on a daily basis, moving their livestock, and controlling the amount and the timing of their grazing, so that they can harvest a product, protect the environment, and maintain open space. Ranchers are those day to day stewards or adaptive managers if you will, of the land. They are the ones that take the daily care of our rangelands and this kind of care cannot be provided by government.

There's been a lot of discussion on the cost of adaptive management, so I penciled out the ranching scenario, based on if the government had to replace the ranchers. There's about 2,500 ranchers in Arizona ranches roughly, and on average each one of those ranches probably supports two employees. So you are talking about a workforce out on the land of about 5,000 people. Each of those two people take care of about 15,000 acres, work seven days a week, are out there every day, and they stay there sometimes for their entire lives. They buy their own vehicles and gas, pay for their own equipment and office space, do their own payroll and their own administration, drive and maintain the roads, pick up the trash, rescue stranded motorists and sightseers, build water developments out of their own pockets, deter poachers of wildlife and people who would collect cactus and other things, and on top of all that, they pay us through grazing fees and taxes to be able to do that.

Now, let's say the government decided to get into that business, the salary for those 5,000 people would be about 300 million dollars. And of course, those are just the field workers.

You would have to have administration and payroll. Just add another third for overhead to buy vehicles and equipment, office space, and of course, overtime pay for weekends and evenings. So who really is providing the day to day adaptive management out on the land? It's Saturday today, who is out there today? The government can't do this.

The range management plans that are developed by the ranchers are very detailed. They take a lot of time, usually as much as a year and sometimes more. They usually have to work with multiple agencies, state and federal, some local, simply because of the intermingled landownership in Arizona.

NRCS provides voluntary technical assistance primarily on the three or four million acres of state and private lands in Arizona. We do get involved in ranches that have federal lands through our coordinated resource management agreement with all the agencies in Arizona. There's an agreement with nineteen land management agencies in Arizona to all work together, so that any individual landowner/land manager is entitled to come to one agency and ask for one coordinated management plan that involves all the other agencies.

I have to talk about our conservation districts because without them, NRCS wouldn't be here. Part of this model you have to build is kind of a structure, if you will, to control all these employees. With this 5,000 employee workforce that's out there, Congress in its wisdom, authorized states to establish conservation districts and the State of Arizona pay's their thirty-four or five conservation districts in Arizona, pays them \$5,000 a year to help kind of coordinate, prioritize, and identify resource concerns and bring those to the attention of the agencies. These are local landowners and they are elected to serve that purpose. They don't get paid, the district gets \$5,000 to cover postage and those kind of things.

As you lay landownership over watersheds, over the pink lines on the conservation districts, that's the only organization that covers all the state, federal, private and tribal lands in the state and it's a volunteer organization. The NRCS provides our services to landowners who voluntarily come to us for assistance and those who ask for our help can get an inventory of their land, an assessment of its condition, help with developing alternatives, help with developing a management plan and documenting those decisions, and cost sharing to install the practices needed to do the management and monitoring to see if the management is taking us where we want to go. Those services are provided by the taxpayer. The voluntary program of technical assistance for non-federal lands to help ranchers develop management plans improves their knowledge of grazing management and monitors the resource conditions to let the ranchers know if they are moving in the right direction.

It's Steve Barker's dream to realize that the agencies are nothing more than the gatherers of public opinion, gatherers of research knowledge and their role is simply to transfer that knowledge and those resource concerns to the land managers. That should be the role of government. Not to regulate, but to train the people who manage the land which is not the government. What are the resource concerns and what needs to be monitored? What if the grazing fees were waived and if the rancher would provide us with a monitoring information?

Inventories are an important part of the learning process. NRCS doesn't go out and do any inventories unless the rancher is with us, it's that inventory process where we all learn together. That interaction between the land users knowledge of that particular piece of property, the agencies public opinion, resource concerns and research knowledge. All that comes together during the inventory process. And it's a process of helping the rancher understand what they're up against if they are going to do management and meet the public's needs as well as produce an economic product from that land.

Range health evaluation is kind of new term but BLM (Bureau of Land Management) and NRCS and ARS and USGS and the forest service to some extent have always kind of agreed on looking at some main components of range land, to assess its health and to try to standardize for all the agencies, one method of deciding where we are. And in those three things, we're primarily focusing on for range health as the stability of the soil, the hydrologic function of the area and the integrity of the community. With the data we gather, we do assessments for grazing for the rancher. We calculate pasture acres and forage produced and how many AUM's could be harvested off that land if it's in fair condition or good condition or excellent condition. This is the information the rancher needs to give him an incentive to make things better; to know how many more pounds of beef, how many more dollars he might be able to harvest if he were to improve the condition of that land. The monitoring data helps us identify the objectives for the management of the land and NRCS's role as a government agency who brings public perception and research knowledge to that producer. We filter that into his stock process in making those determinations. If all of that is done well, the rancher writes his own plan and NRCS does not write any management plans. We document and produce their plans.

We do a lot of paperwork and the only reason we do it is to help that producer document what he thought through and what he came up with for a plan of attack. And if he's willing to do that voluntarily, then what we promise as NRCS, is that we will be out there working with him every year, helping judge utilization of the pasture, monitoring the vegetation changes on key areas on the ranch and assessing the foliage that's produced each year. Because you can't set up a grazing schedule on a calendar and expect it to work year after year. We looked at what happened that year and what we have to deal with to help the rancher put that plan together for the coming year. We locate permanent monitoring sites. At last count, I think we were in the six or seven hundred sites around Arizona that we have to establish to help ranchers gather information.

And that in termination is feedback that the ranchers get from us to help them make better decisions. Somebody said if we had started this twenty years ago. Well, I know of at least twenty ranches that I've been involved in monitoring for twenty years now. Our planning process, the NRCS assistance to the producers, is really just an independent agency providing a scientifically based assessment of the research conditions on the land to the adaptive manager who has to take all that and figure out what to do with it. This voluntary relationship between ranchers and NRCS has improved range conditions on thousands and thousands of acres in Arizona. One of the things that NRCS is responsible for is the National Resource Inventory, where we go across the United States every five years and assess the health of the nations resources for the Congress.

This is NRI data, National Resource Inventory data for Arizona. We collected range condition information in 1982, 1987 and 1992. These are the acres of excellent condition and you can see a strong trend increasing thousands of acres into excellent condition in Arizona. Good condition range land also increased over that ten year time period. Fair condition range land took a jump in '87. Those of you who remember, '87 started kind of a drought of '89 and that was a tough three or five years through there. It then significantly dropped in '92, so acres of fair condition are going down and they are becoming good and excellent condition. This is all non-federal lands in Arizona. And poor condition acres have declined steadily. That's my story and I'm sticking to it.

AUDIENCE: inaudible

We would describe the native historic plant community and that would be our management goal or our long range plan. There are large parts of the United States where you can no longer find a native historic plant community and those condition ratings that you saw compare the current plant community to the historic potential plant community. So if you have nothing left of a native historic plant community, you are always going to be in poor condition regardless of whether there is a plant community now on that site that is protecting the soil, maintaining hydrologic functions of the site, and providing the biotic integrity for at least some species. So range health tries to erase that bias. Just as a site stable, is the waste precipitation being absorbed and distributed like it should it be and is the biotic integrity intact? With the preponderance of evidence of all of those, you may discount the health based on introduced species. But if it's stable and the watershed is functioning, it's probably healthy.

AUDIENCE QUESTION inaudible.

The 2,500 ranches in Arizona would represent all the ranches on state, private, federal and tribal lands. At the last count I had from our field offices, we were working with about five hundred ranches. I have twelve full-time range specialists out in the field; those day-to-day adaptive managers. The State Land Department has seven. You know, if you add up all of the full-time "on the ground managers" of the agencies you are looking at, there are one hundred to one hundred fifty people compared to five thousand producers out there every day. One range can handle forty or fifty ranches if they are very experienced and that allows us to visit each rancher maybe twice a year and do this monitoring. So, we have all the work we can handle. Every range is fully employed, but there are new producers coming in every day. The demand is always there and people get frustrated with us because we can't get to them.

**Dr. Bill Shaw --**

Well, I'll echo what you said there. If the whole State of Arizona functioned like the Empire-Cienega Ranch, we'd be well on our way to the Sonoran Desert Conservation plan goals in a sense that it is an example, at least, of conservation goals being integrated within a 72,000 acre ranch that still is ranching I believe. So we're very fortunate to have the rancher, a long-term family that has been involved in ranching a long time, Mac Donaldson who manages the Empire-Cienega, to describe how they address this day to day adaptive management.

## V. Mac Donaldson

We're not going to see much in the slides. That's the Empire-Cienega, 72,000 acres, predominantly BLM and state land, about fifty-fifty. And I was going to say, that when I came here this morning I had been around pretty much because of gathering and putting the bulls out and changing from our winter program to our summer program. I've been around cows for the last couple of months and I didn't even know that adaptive management had specific science or books written on it, you know. I had no idea of that and I wanted to give a little talk.

Bill had said that, you know, maybe when you were seventeen you started. I hope that this doesn't offend anybody. But there are two women hanging up clothes outside in Arizona. And it doesn't take too long to dry your clothes, and one woman says to her friend: "I'm having real trouble with Johnny because he keeps swearing all the time and I just can't get him to stop swearing and I'm really concerned about him." And the other gal, she has a dramatic heritage like my mother and she says, "Well, you just have to spank him when he swears and he'll get the idea that you just can't keep doing that." So the next morning he gets up for breakfast and goes to the table and his mother says, "What would you like for breakfast Johnny," and he says, "I think I'll have some them damn Post Toasties," and so she just hauls off and hits him and he falls off his Chair and gets back up again. And she says, "Now what did you say you wanted to have for breakfast?" Then he said, "I think I'll have some of them damn Post Toasties," and she just hauls off and hits him again and he gets up, shakes his head. Then she says, "And now what are you going to have," and he says, "You can bet your sweet ass that I'm not going to have any of those damn Post Toasties." So he adapted a little bit, you know. He changed and he wasn't going to have Post Toasties.

We don't get Post Toasties all the time when you're in agriculture, I don't think. And I tried to remember of any two years, back to back, on a twelve month cycle, where you have the same vegetation and the same situation you are dealing with. We're looking at harvesting what God gives us through rain and soil to produce meat to eat and other aspects like leather, insulin and all those other things that come from it, by-products. But, that's what we're basically doing and you will pick one year where you'll have a lot of winter moisture and so you'll have a good bean crop. Potentially, you'll have a lot of blossom and you'll have a windy spring and you won't get any beans. The very next year you have the same kind of moisture pattern, you don't get the wind, and you have a lot of beans. One year you have a situation where you are going into a breeding cycle where your cows are in real good shape and you are able to have lots of calves and the next year, you will have a death loss at 10%. I mean it's just that dramatic.

Historically people came out from agricultural backgrounds, East Texas, Oklahoma, Mississippi. They came out here and they tried to apply those practices to management and it didn't work because we're in a desert. It took a long time for that management, that adaptation of management, to come out. And those people that were managing like they did in Okmulgee, Oklahoma, they're gone, or if they're here they adapted. So what happened is that range science, if you want to call pushing a cow science, changed.

After World War II there was some philosophies that came out that said this is one way to do it, this is another way to do it. You rest, rotate, and you have summer follow. You do different aspects to manage your resource and that gave you tools to be able to manage those resources. So through the generations people, their fathers and their fathers did it this way. Their son's went to the University of Arizona, got a little bit of information and did it this way. The next son ended up in the Army and learned a little bit something different and therefore did something different. So you had a change, but the science kind of kept with it and that was an adaptation. The adaptation was through trial and error or mistakes, and that's what we all do.

The Empire Ranch history basically started out traditionally, where the water sources were the Cienega Creek and the springs that were in the adjacent mountains. Land was proved upon and that became the deeded land and the other land was basically the State of Arizona land. The Vail Family put that land together from about 1875 until the mid 1920's when they sold it to another family, who kept it going up until the mid 1960's. Then it was sold for development. The development ran into problems with zoning and finances, and so in 1988 it then became federal land. In the interim Anamax Mine came in and bought the land for the potential of the hydrologic mining of the water for use in some of their copper reserves in Helvetia. That's how we came into the picture. My father, in 1975, started running cattle down there in cooperation with Anamax Mine. Then when the BLM purchased the ranch in 1988, they honored our lease and we stayed.

The BLM came in, and because they became the owner of the private land, it became federal land, and all the mandates that come with the Bureau of Land Management and federal lands, then became our issue. We could lock the gates before, deny access, and do whatever we damn well wanted to. If we wanted to root plow for mesquite, put herbicides on, or do control burns, it was between us and Anamax Mine. We actually had a situation where we had a beneficial lease, in that 50 percent of the money that we put into our lease went back into resource management, whether that be fencing, dirt tanks, vegetation control, or whatever. So the money that we were leasing actually went directly into that property. Whereas now, the money that we lease goes to Washington. So, it was a completely different situation and we had to adapt to that change and that management.

That's the broader view. Well, when the BLM came in, their goal in purchasing that property was to try to tie a way through. If you want to call it wild lands or the Sky Island Alliance, which is based here in Tucson and has that same sort of concept, it's trying to develop habitat from the Mexican Border tying into the forest lands of the Coronado. That was the main purpose for the purchase of the land by the BLM. Another purpose was for water. The water issue is important. The Sonoran Desert Conservation Plan is dealing with ranchers because ranchers control the water and the water is where the habitat is. That's what you're going to have to do to protect the species.

It's fairly simple. That's the Cienega Drainage going to the north. I think another thing that possibly could have happened was the idea that the southwest has a burgeoning population of people, and there was an attempt to try and tie up some of that land so that it wouldn't be developed.

I think that a lot of us use open space as a pat on your back for doing something good for the community. You can say that I produce beef and that's good for the community unless you're a vegetarian. We can all validate our position, but the fact of the matter is that land is controlled by ranchers and their leases, and it does tie into open space. So that is an issue that is part of the Sonoran Desert Conservation Plan.

Here's just a little slide that I got from the BLM. These are species on the Empire-Cienega. There's two hundred and thirty birds, sixty mammals, forty-two reptiles and amphibians, and three fish, all of which are native. That was a big aspect of why the BLM purchased the Empire-Cienega, because they did have these three native species, which are threatened and endangered.

This is what the creek looks like now. A lot of it has been fenced off and I'll go into that later. There's the Gila Top Minnow which is the main threatened and endangered species on the ranch. We have seven threatened and endangered species on the ranch. Here's the Sonoran Chub. And that's a gray hawk, a native gray hawk. So those are aspects that have to be part of our adaptive management and our change.

Okay, we have adaptive right there. So, if it was private land and maybe the Fish and Wildlife Service hadn't had an alarming call from the Southwest Center for Biological Diversity or some other, what we ranchers call "do-gooder," we probably would be perfectly happy. But that's not the case. We have to deal with this and I was going to sing a little vignette of "Home on the Range, where the antelope play," but I can't sing, and I know that because every Sunday in church, there's a new set of people in front of me.

I think that knowledge is all integral to where we're at as ranchers in Pima County. I'm trying to tie it back into what we're doing on the Empire-Cienega. Basically we've got a situation where we're having to deal with a multitude of positions. Fish and Wildlife deal with endangered species. Game and Fish deal with the mule deer, javelina, and the habitat therein, or even commercial fishing, which is not allowed on the ranch. We have state lands, we have BLM who owns the land, we have ourselves as ranchers, and then we also have people that are concerned citizens, or environmentalists who come into us through a process called the Sonoita Valley Planning Partnership.

This partnership was set up by the BLM, because the Taylor Grazing Act was in 1934, to mandate that all lands have a policy on them, stating how they are managed and what's done upon them. Because the Empire-Cienega was purchased in 1988, those management policies had not been in place. Therefore, they had to be reviewed and looked at and that meant that the federal government had to make a plan, a resource management plan for this new acquisition. And, they tried two times to get going, but they couldn't get it going. Finally went into a process where they put it before the public which was the Sonoita Planning Partnership.

The partnership came back with what they the people within the area wanted to see. People had input and that brought people into the process that had commitments that weren't economic like the mine. They were purely emotional. "I hate cows and I want to see a wolf preserved. I want to see open space. I want to see ranching preserved. I like hunting out there." Whatever their individual needs were, they were all opened up and then they became part of the process.

And as in 1993, which is about eight years ago, we started a biological planning process. This was done really in an effort to coordinate these different management needs and requirements upon the ranch, as to aspects about what was going on with the ranch, what our moves were and how that would be affected. So we set up this at the beginning of the growing season and at the end of the growing season. We as the grazers, probably at that time, had the most potential negative aspects on the resource.. Now recreation is catching up quick. So we developed this where everybody would come, look at it, and discuss issues. The object was to get the confrontation on the table before it became confrontational, and also to allow input. That's a risk factor. For instance, "I'm telling you, Joe, how I'm going to run my cows," and he has input to tell me what to do with my cows. I have an economic incentive, what does Joe have but the seat in the chair?

AUDIENCE inaudible.

Do you see what I'm saying? It's a risk factor and you have to have a risk factor there. But, you create trust when you start to react to those aspects. You start to listen and learn, and if you are a good manager, your goal is to try and have the best resource you can. That means that the resource is in good shape, your cows are in good shape, and so your bankbooks are in good shape. It's pretty simple economics. And, if Joe has input that I don't see because he happens to be looking at it from a different perspective, hey, that's all to your advantage. You have to turn it into a positive instead of a negative.

I'll give you an example, which some of you in here have heard before, but some of you haven't. We had a situation where we had about 800 cows along Cienega Creek. We had our biological planning process and we had said that we were going to go in and we were going to graze the Sacaton Bottoms like we normally do. It's a prairie grass which greens up early because it has a deep root structure on a loam, a bottom, which it usually holds as the moisture. And it's very beneficial to us. It's almost like having a feed dealer right next to us because it starts to flush those cows and get them ready for when they are calving, to breed back in the most detrimental time of year which is May to July. That's the hardest time of the year. It's like January or December, to Bismarck, North Dakota. May, June and early July, that's the toughest time here in Arizona. You are trying to calve and breed back, but it's hot and there's no water. The cows have reduced down to an area where they can drink as they are lactating and it's a mess.

Anyway, we had the Sacaton Bottoms which are really beneficial to us and we can get those cows in shape to breed back and we got a phone call saying, "you can't use the bottoms. You cannot be adjacent to the creek. You can't be in the creek, using the creek."

My Dad had a complete coronary, threatened to sue and said, "You can't do that to us. We have the grazing rights." But what we did was, we sat down and ruminated on it, and talked about it, and I was really on the other side of the fence. I was really saying, "Dad, don't give in to them. The cattle aren't hurting the damn top soil. They've been here for 200 years and they're still here and we've got the best top soil habitat, so how can they prove that the grazing is not beneficial to the habitat because the cows and fish are coexisting?"

But that really wasn't the point and he had seen examples where he had tried to close off some wildcat roads going through the creek. He had seen that when you deny the cattle into the creek during the growing season, the growth of the creek was just absolutely amazing. And he said, "Let's bypass it this year." Well, for all of those who have economic concerns, that little decision, that little phone call, cost us, and I told this to Maeveen and she got a big laugh out of it, cost us \$50,000 conservatively. That one phone call cost maybe as much as \$80,000. That's what we took from making that decision. Because our cows didn't flush, our cows weren't as heavy, and we didn't get the breed back. We had two years of cash crops affected by that one decision.

The result was that we decided we weren't going to do that again. We fenced the creek. We fenced it in cooperation with money from the Bureau of Land Management. Now we have a situation where we've created trust within the environmental community because we made the commitment for the fish. The creek is in much better shape. Actually we've gotten into a situation where we are subbing our Sacaton Bottoms and we're getting a much better ecological situation on the feed that we count on. From the point of view of Mike Seidman, who is an environmentalist from Phoenix who works for the Phoenix Zoo, the entire habitat is benefitting. Maybe the Gila top minnow habitat isn't benefitting that well, but the entire habitat. Frogs, garter snakes, willow flycatchers, whatever the hell it is, they are all benefitting because the creek is in better shape. It has dramatically increased to being better and that has turned that negative into a positive for us too. We're having a better resource to graze, we've got a better situation philosophically within the community that was against us, and we've shown that we are committed to the resource enough to gain that trust.

So there's another group of us out in the field discussing whatever the particular reason is we're meeting at that point, and you also have a benefit. If we're looking at one issue, how's the best way to solve the traffic problem at Campbell and Glenn or some other thing, if we get people that live in the area and that work there and are there everyday and see it, they are going to make a positive input into the decision that the County planner is going to make. You get somebody that's from Phoenix making a decision about it, then maybe it's not the best decision for what's going on here. And so these people are making decisions and trying to work through the issues.

Say you have a complete, old historic wall built on the Empire, but you don't want to get stonewalled by that. You don't want to hit that brick wall and just figure it's not going to be an advantage. It is an advantage. You can put a calf under there and it won't be so affected by the sun. It will be shaded, or whatever. Do you see what I'm saying? It helps you.

As I said, the water's the issue and the water is where the control is. Her deeded land happens to be the habitat for the Chiricahua Leopard Frog, whatever that is. It's not because it's her land, it's because it's where the water is. So you have to be aware of these species that the Fish and Wildlife Service are going to tell you what to do with. They are going to make decisions and if you don't believe it, just to go Austin, Texas and see what happened with the warbler over there. So the thing to do is to not get stonewalled. Don't see it as a negative, instead try and see it as a positive. Get on board and try to figure out what you can do and what your needs are, and try to be there to represent that need. And who knows, we've been doing it for eight years and survived and maybe we'll be there for another eight or another eighty. I'd like to see us there another eighty. I'd like to see us continue to graze cattle there, but that's from my card drawing. If I can't have Post Toasties, then I guess I'll have Corn Flakes.

AUDIENCE: You said that recreation (inaudible)

Yes, getting back to the water. The largest problem with what the Soil Conservation Service looks at, is soil conservation. Let's go back to the name and what grazing can do. If you have extreme grazing, like say you have a corral where a horse is, there's nothing but rocks on that ground and the soil washes away. That's what's going to happen with extreme grazing. But when you take moderate grazing or responsible grazing you are trying to promote grass and vegetation to hold that soil. Then with recreation, they don't particularly want to have grass from a conceptual or a panoramic point of view, but they want a road, or they want a trail, or in the extreme situation, they want to dirt bike it. That has nothing to do with growth.

What I've seen in the last ten years on the Empire Ranch is pristine canyons that we worked for twenty-five years just to get a little bit of soil in the creek. Let's say the creek is the width of that screen, when we came there, that creek was 100% sand from bank to bank. But right now, 30% of the stream is sand and 60% is grass. It took twenty-five years to get to that point and what's growing in the sand or the vegetation are weeds and annuals, but it is vegetation. It is retarding that erosion.

But now it is just turning back to straight sand because you've got motorcycle tracks all up and down it. If you have a water event, a rainfall, it's going to go and it's going to take that vegetation. But the recreationalists don't see that. They're there to recreate and so that's what I was saying, but I can't give you figures Kevin.

QUESTION: What did you do when you said you fenced it so the cows could go into the bottom?

No, I fenced so they couldn't have access to the creek. They were still allowed. It was called a riparian pasture but they weren't in the actual creek. Therefore, they weren't grazing on young cottonwood saplings and young willow saplings.

QUESTION: But they still had enough forage to do what they need to do?

Yes and getting free water from the creek was an advantage. Now we have dirt tanks where we have to pump the water with a gasoline generator, so that we can utilize that forage. Our cost has gone up because of instead of having free water, we now have gasoline assisted water.

QUESTION: Maybe in a couple of years you'll get that management going?

Yes, about two. The fencing cost us about \$30,000. Then it cost the BLM maybe another thirty. Then there was the costs of placement of those wells and the water tanks.

QUESTION: How did these four-wheel drive guys get in there?

Oh no, there two different areas. We're talking about a sand wash on oak tree drainage as opposed to Cienega Creek.

QUESTION: They are getting in there when it's dry?

Sure, that's not perennial. When I was talking about the cattle, that was a perennial stream. This is a dry stream bed. Any other questions?

QUESTION: inaudible.

I'd say it was pretty stagnant if you look at it long term, especially when you compare it to the dramatic list of fencing. In the winter grazing area we have access still, passed down by the Fish and Wildlife Service. We've seen a constant up trend with winter grazing. But in summer grazing or spring, which is when we were doing it, we heavily rely on the Sacaton. It was probably pretty much at base zero. So when the summer rains would come, we'd get out and go to our upland pastures because they are better and no cow in its right mind is going to stay in this section where the bugs are terrible. It's just absolutely a humid mess down there. They all get out which is the natural way. Thank you.

## VI. Dr. Tom Sheridan

Okay, are we ready to kick off the second part of the program? My name is Tom Sheridan and I'm chair of the Ranch Conservation Technical Advisory Team. Before I start I'd like to thank both the County and also Diana Freshwater and the Arizona Open Lands Trust for sponsoring the first of a series of workshops. Do you have a schedule for the other workshops yet?

August 18 is the tentative date for the next workshop and it will be on conservation easements.

I just want to say a few words about what the ranch conservation team is doing and also how we've been collaborating with the Science Technical Advisory Team (STAT). I think the STAT team got beat up a little this morning for things that really aren't their responsibility. As Bill Shaw mentioned, their charge is really to present the County with the best biological information available, it's not to determine policy, and it's not to implement the process. It's to provide the steering committee, the County staff, and everyone else who is interested, with what we know and also what we don't know about the fifty-six species listed as vulnerable.

As far as getting out and leading the public, I know that the Ranch Conservation Team and the Stat Team have collaborated in two or three joint field trips to ranches in different parts of the County and of course, those were all open to the public under the open meeting law. We also have had one informal meeting between members, the STAT team and the Altar Valley Conservation Alliance, which was held at my house about a month or two ago. So the STAT team is making an effort to reach out to the community.

We all know that we all have to do a lot more and I think that the primary responsibility of the Ranch Conservation team, as we enter this new phase of the Sonoran Desert Conservation Plan, is to structure more of these sort of informal meetings in different parts of the County with ranchers and other landowners, and give them the opportunity not only to meet us and share their concerns with us, but to meet other members. They could meet members of the STAT team and members of RECON, a firm that is preparing the preferred biological alternative.

The meeting that we did have with the Altar Valley Conservation Alliance was very well received. But for those ranchers in other parts of the County, I would really appreciate if you would give me contact people, help us set up more of these informal meetings, which again are open to the public. They aren't restricted just to the ranchers of a particular area, but I think that the Ranch Conservation team's primary responsibility is to provide the steering committee and the County staff with the best possible information about ranching in Pima County. Our second responsibility is to make sure that rancher's concerns are accurately represented in this process. I think the best venue to do that is to meet with the ranchers. I mean these general workshops are fine and they're very useful. But I think to achieve the level of understanding that we need to achieve before we can forge the trust that we're going to need to forge to make the plan work, I found that it's more effective to meet in smaller groups.

So for those of you rancher's from Avra Valley or the San Pedro, the Empire-Cienega area and other areas of Pima County, please let us know who you are and when we could come meet with you.

I think this is the way that information and hopefully, trust will really be developed and I think with a process this big and this complicated there is always the problem of misinformation flourishing. All the different stakeholder's may not agree about what they want the plan to accomplish, but I think we need to reduce the level of misinformation and hopefully reduce the level of paranoia that some people are feeling, so that if we have disagreements, they are honest disagreements and not manufactured disagreements. So again, for the ranchers in different areas let me know how we can set up the kind of meetings that we've already had with the Altar Valley Conservation Alliance.

Are there any questions about the Ranch Technical Advisory Team before I move on to the speakers themselves? Well then, let's move right along. The first speaker that I'd like to present is Walt Meyer who describes himself as a damn rancher, but he also has his Ph.D in range management with a minor in soils from the University of Arizona. He's currently Chair of the Winkelman NRCD and he also ranches in the Winkelman area, a ranch that has been in his family for several generations and on which he grew up. So it's my pleasure to introduce Walt Myer.

#### **VII. Dr. Walt Meyer**

Thank you Tom. I have to admit I'm a reluctant speaker this meeting. I really don't like to make public speeches, but it so happened that I think this came out of some partnership the Winkelman District had with desert archaeology. I'm not sure how I got sucked into it. I had a lot of voice mails from Linda. I tried to avoid them and even went to Phoenix to try to avoid her, but she finally was able to catch me. I just came in the house and had heat stroke and she says, "I thought you will give a speech," and I said, "I will?" So that's basically where this comes from.

I didn't know that the Winkelman District was having or we were operating under adaptive management. I always thought we were just kind of getting along. I guess some of us old farts are going to have to learn to accept this politically correct terminology. How many of you guys know what a Natural Resource Conservation District is? Steve Parker, earlier this morning, alluded to it. Well, there's quite a few of us then. Within Pima County there are five NRCD's. The major one is Pima NRCD, the Tohono O'Odham Soil, Water and Conservation District, which is on the reservation. The Reddington District takes in part of Pima County as does the San Pedro District. And the Winkelman District is the other one that takes in most of the southern boundary within Pima County.

There are, as Steve alluded to, 35 districts within the State of Arizona. We are a political subdivision of state government. We are funded with \$5,000 from the State Land Department. We are all high-paying staff members, all of the Supervisors are. We get to pay a lot of money out of our own pockets to do the jobs that the district needs.

It's kind of interesting, we have Pat King associated with the Pima NRCD. We've got Andy Smallhouse with the Reddington NRCD. It costs the State of Arizona \$175,000. A study by the State Land Department showed that on average, forty-five days out of the year, each supervisor provides services to the district and that's just average which I think is a pretty big amount of work.

All of the districts function similarly but some of us are a little bit different in many respects. Each district, by law, has to file a long range plan and I think this kind of goes along with what we're discussing today. A long range plan is kind of our guidelines to the objective of the district for resource conservation, not necessarily just natural resource conservation. We also include in these plans reclamation on mined lands, education to our youth and stuff like that. Each year we have to file an annual plan of work which addresses how we are going to accomplish our stated goals and our long range plan. These all have to be filed with the Secretary of State.

I'll talk mainly about the Winkelman District because that's the one I know the most about. The Winkelman District encompasses approximately 1.9 million acres. Of those 1.9 million acres, the majority of it is State Trust Land and you have to realize that State Trust Lands are not public lands. People have a hard time realizing that State Trust Lands were set up by the federal government through our Enabling Act for fourteen categories. These include our universities, our state hospitals, our state school section, our state schools, the state buildings and there are a number of other trusts they go to. But these trust lands are to generate monies for those fourteen categories. We also, within the Winkelman District, have the Coronado National Forest and the Tonto National Forest. We also have BLM lands that are administered out of Tucson area office, the Safford area office, and the Phoenix area office. Our district covers most of Eastern Pinal County and Southern Gila County so we have a fairly large and diverse group of people that we do work with.

Partnerships are something that we all have a problem with. Partnerships kind of means that there's an equality. The problem with having equality on private lands is that means part of your private lands belong to me. As a result, the district has a problem addressing it as partnerships. We just address it as members of cooperators and our function is to provide the best technical knowledge to those participants or at least find somebody that can provide it for them.

Well, our district members, our cooperators, are very diversified in range. We have high school's, the Ray High School, the San Manuel High School, and there's a desert archaeologist, one of our members. We also function with BLM, the Forest Service, State Trust Land, BHP Copper, and ASARCO. So we have a number of different people that we work with. We also work with the university and we work with the Nature Conservancy. The people that we associate with are large and diverse.

The way we develop our long range plans is through our public meetings. Our public meetings are usually between thirty-five and forty, sometimes fifty members, and that's how we develop our long range plan. We also develop our annual plan of work from associating with these members.

We have found in the past that the best way to get participation is to have a mutual trust, a mutual interest and a mutual respect. So it's been kind of the demand of our board or our district that we sit down with State Trust people. We have sat down with BLM people and Forest Service people, and all of us sit down together at our district meetings and have an open rapport. It's very much the same as this here.

Through this process our district has approximately eight-five percent of the district under a conservation plan. This plan is very much the same plan that Jim Chilton and Sue Chilton would have on their place. These conservation plans, as Steve alluded to earlier, cover a multitude of different objectives, but it is the cooperator that develops those objectives. In the past, the district board has made it a resolution that we cannot get resource management with a baseball bat. In other words, we cannot come in and tell somebody that he needs to do something or that the regulations require him to do something. If you try that approach, it is usually confrontational. If you can do it with rapport, with respect, you can get a lot of things accomplished. Maybe I'm rambling a little bit but that's typical of me.

I'll give some examples of the projects that we get involved with. The Ray High School has a science team, they were trying to earn money to go on an oceanography trip. It was off of Catalina Island. They needed the money and we needed some projects done. There was a noxious weed that was growing in the Oracle area that we had removed. It was planted in the past by the soil conservation service or it was one of the plantings that was put in our task. We hired those kids to dig those plants, but in the process they got to work with the Dan Robinette from the Natural Resource Conservation Service, and the Arizona Highway Department, and Arizona Game and Fish. So I think they learned a lot on that trip.

We also had them work with the University of Arizona at the Page Ranch, this dangerous toxic dump that we have and everybody's worried about it. The Page Ranch belongs to the University of Arizona. We had some erosion problems on that and the University is a cooperator with our district, so we had the kids come out and throw rocks in a ditch.. They got to associate with University people, with a rancher, and with technical people. I guess what I'm trying to say is that the citizens within our district are our major resource.

The process I think that Tom was talking about is outreach through. I don't know how to really put this together for him, but the way we try to reach our ranchers is that a majority of the district is made up of ranches. We do have farms, and mining, but we can get the mining industry talking to the ranchers and the ranchers talking to agency people. We develop our plans that way and nobody is isolated or feels like they have been stepped on. I'm sure glad I only have to talk for ten minutes because I think it's pretty well up, isn't it?

I would sure appreciate any questions if you have any. Nathan?

QUESTION: when people start.....?

Whenever these large ranch holdings or the larger ranch holdings are busted up into the forty acre parcels or whatever or even subdivisions, we don't get resource management. I'm not sure if I'm answering your question correctly, but we don't get participation. What we end

up getting is twenty-five or thirty horses on a forty acre parcel and then it gets to the point that was alluded to earlier. I think Mac alluded to it. You lose your grass cover and your soil and you end up with bare rock. You do not get these people to cooperate with you because they do not understand resource conservation. We try to reach those people but most of the time they want to do their own thing. We try to direct them toward the Natural Resource Conservation Service or a University Extension service or something like that where there is some expertise, to get them out and get some resource management. But most everybody wants to do something with their own land, you know, "it's mine. I'll do something with it." So we don't have a very good batting average on getting to those type of people.

Mac?

One of the things the district tries to do in their management plans is to reduce numbers in times of drought. Some of the stuff that Steve presented in '97, '98 and '99 during that drought period was that a lot of people reduced numbers and that is a management technique. That is written into the conservation plan. But by the same token, the districts have the power to have the Farm Service Agency provide funds for the rancher to be able to buy hay, if he needs to buy hay. They also have another program where they can put in more water. That's on a cost share program similar to what you did with your fencing through BLM. Most of that money goes on to State Trust Lands or onto private lands. It's not necessarily used on federal lands. But that is something that is written into all of the conservation plans and the districts are very active in trying to get those plans developed along those lines where numbers are adjusted in times of drought.

One of the other things I thought was interesting in the comments made this morning was mentioned when talking about monitoring. There are ranches within our district that have been monitoring for probably close to forty years. There are some in the Pima NRCD that I know have been monitoring at least that long and have conservation plans on them. One of the things they were talking about earlier is that it takes a long time to monitor change but that's not really so. In 1987, '88 and '89 the trend was down and we had an abrupt change on a lot of our monitoring sites. It went from a grassland to a scrub just overnight basically. So we cannot recover those scrublands back to grasslands just through management alone.

So there are some monitoring transects out there that have been established for a long time and yes, some of the transects show immediate change within very few years, but stable is good. Some of these transects on the slashes have been in there for twenty-five years and the trend is stable. That means that it is not changing, even under good livestock management or poor livestock management. Some of them are not changing so we consider that as a valid monitoring. Tom?

TOM: Yes, could you give us a better idea of what these conservation plans involve? I mean what are some of the topics that you cover?

Conservation plans, like Steve alluded to earlier, involve an inventorying of the ranch. The inventory covers the ranch boundaries and all of the improvements. A lot of times they even include the cultural features on the property. They have a place for livestock numbers.

Included in the conservation plans is where the livestock are going to be and when they are going to be moved. But most of them are fairly flexible so that if something goes wrong in one pasture and you needed to move to another pasture you can do it. Mac kind of alluded to it earlier, that one move cost him \$40,000. Is that correct? Fifty thousand and we don't like to see that kind of thing. There needs to be more flexibility in the plans so that kind of thing doesn't happen. We need to maintain the economic viability of the ranching unit. Monitoring is a big thing.

QUESTION: Do the districts as whole have conservation plans or is it just individual ranches?

Our conservation plan is actually our long range plan. That's the way I would define that and it addresses a lot of other issues other than just grazing. We address endangered species and other environmental factors that go along with the plan. But that's in our long range plan. Our annual plan of work addresses how we're going to do that, but the ranches within the district have their own conservation plan. They are developed by the rancher himself with our support or our aid, with the aid of Natural Resource Conservation Service or BLM or State Trust Lands or the Forest Service. We cannot do it by ourselves. We have to have the cooperation of the rancher and he has to be willing to do that. One of the problems we do have is this rapid change in ownership of ranches. Everybody goes broke pretty quick so we have a turnover. Then we have to have a new plan filed on the place. They all have a different objective, so we have to develop a plan for that particular owners objective.

### VIII. Summary of Issues

Well, we've got about ten more minutes before we hit three o'clock and there is supposed to be a summary of issues and discussions. I think we're entering a really interesting phase of the Sonoran Desert Conservation Plan now because we really have to start talking about the nitty gritty. We've heard a lot about the theory of adaptive management and possible ways to monitor. We've also heard that a lot of ranchers are already involved in monitoring programs. But I think that now we start to enter the realm of the economics and the politics, which really is going to determine whether the plan is a success or not. Also, I think that certainly from the ranchers point of view, there's a number of very basic questions that they're going to want answered about adaptive management.

Probably the foremost question is who is going to make decisions as we monitor? As conditions change? Who will decide if a particular management strategy is going to have to be modified and to what extent it's going to have to be modified. Understandably, the ranchers of course, are very concerned that this doesn't become another very burdensome regulatory process. So I think that's something that the County and Fish and Wildlife are going to have to provide us with more information about and these are questions that obviously the steering committee is going to have to grapple with.

Other more basic question about the permit, if a permit is issued, is just what are the parameters of the "no surprise" clause? I think that ranchers and other private property owners are interested in the plan and will support the plan if they feel that it gives them some

stability and some predictability, and if it makes them less vulnerable to the very litigious environment that they've been living in for the last ten or twenty years. So I think one of the things that Fish and Wildlife needs to share with the rest of us is just what are the parameters of that "no surprise" clause? What does it mean that no other species other than the fifty-six vulnerable species will be introduced?

I think there's these very basic questions that need to be addressed and they need to be addressed earlier rather than later, because if they're not, again the mistrust, suspicion, misinformation can flourish. I think we have to remember that even if we can get the best scientific data available, this is going to be a very political process. Also, the more transparent the process can be, the better the possibility that we'll achieve the level of kind of informed trust that we'll need if the plan is going to succeed. So those are my summary thoughts on the next phase of the process that we're entering into right now. I don't know if any of you have questions or concerns, not just on the presentations we've heard this afternoon but also on this morning's presentations.

Well again, we'd like to thank the Arizona Open Lands Trust as well as the County for sponsoring this first of at least four workshops. I'd also like to thank the Sonoran Institute for providing some of the funding for the workshop and thank all of you for attending. Again, particularly for the landowners in different parts of Pima County, the Ranch Conservation Technical Advisory Team would like to hold smaller meetings in your area. So if you could let me know who I should contact and who you represent, I would really appreciate it. Bill, do you have any final comments? All right, thank you very much.



***Adaptive Management:  
What it is and what it means***

**Robert J. Steidl  
University of Arizona**



## ***Outline: Adaptive Management***

- Background and Philosophy
- Definition
- Process and Challenges
- Is it working?
- Suggestions



## *Traditional Management Approaches*

- Conventional wisdom
- Political and social concerns
- Best current data (which might be none)
- Traditional management is itself an experiment



## ***What Adaptive Management is not***

- Monitoring with reaction to unexpected management impacts



## ***Adaptive Management: Background***

- Developed in the 1950s for industrial operation theory
- Developed for natural resources in:
  - Holling, C.S. 1978. Adaptive environmental assessment and management. Wiley.
  - Walters, C.J. 1986. Adaptive management of renewable natural resources. McMillan.



## ***Adaptive Management: Philosophy***

- A structured process of “learning by doing”
- Perform management experiments as research projects
- The information gained is used to revise management or policy through built-in feedback mechanisms

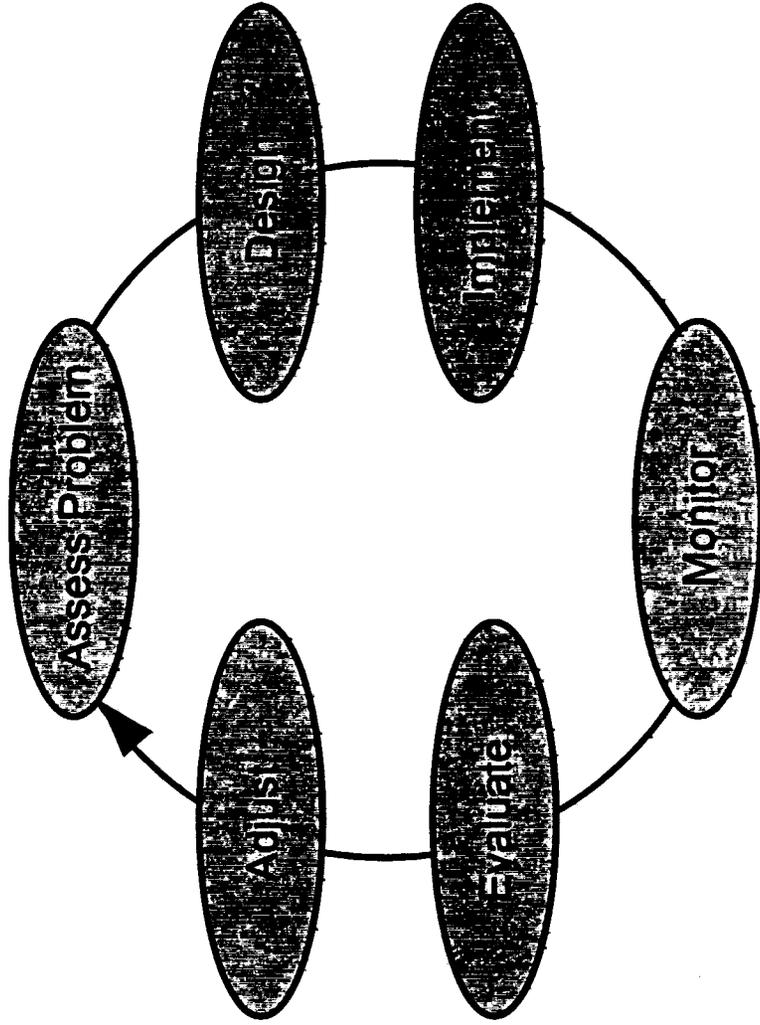
## ***Adaptive Management: A Definition***

A process for continually improving management policies and practices by learning from the outcomes of management programs.

Management programs are designed to experimentally compare selected policies or practices by evaluating alternative hypotheses about the system being managed.

*Modified from Forest Service of British Columbia*

# *Adaptive Management: Cycle*



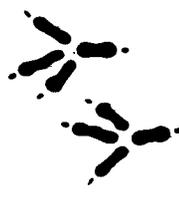
## *Assess the problem*

- Acknowledge uncertainty about which policy or practice is “best” for a management problem
- Bound management problems with explicit:
  - Objectives
  - Constraints
  - Breadth of factors
  - Spatial and temporal scales



## *Design*

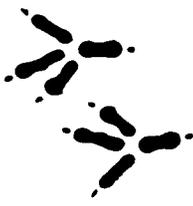
- Represent existing understanding through models that recognize assumptions and make predictions
- Incorporate uncertainty inherent in the process
- Employ basic principles of experimental design
  - Use Controls
  - Replication
  - Randomization



## ***Implementation***

**Mechanisms to:**

- **Apply treatments**
- **Collect and analyze information**
- **Generate the funds and build the infrastructure necessary to support these efforts over the long-term**



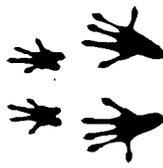
## *Monitor/Data collection*

- Species or Groups
- Parameters
- Methods
- Sampling design
- Sample sizes
- Effort allocation
- Data analysis



## ***Choose Species or Group***

- Depth of prior knowledge?
- Which species?
- Species of concern?
- Indicator species?



## *Evaluate*

- Analyze outcomes of management experiments by comparing with initial objectives



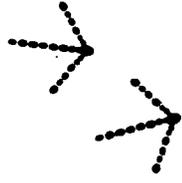
## ***Adjust policy or practice***

- Develop institutions that are amenable to adaptive management
- Design balanced policies and integrate new sources of information and understanding
- Incorporate results into future decisions



## *Has Adaptive Management been successful?*

- AM has been more influential as an idea than as a practical means of gaining insight into ecosystems
- AM should be used only after all concerned parties have agreed to an agenda of questions to be answered



## *Why low success rate for Adaptive Management?*

- Carl Walters involved in 25 AM planning exercises
- Only 7 have involved large-scale experiments
- Only 2 were well-planned with adequate controls and replication
- The remainder have “vanished”



## ***Why low success rate for Adaptive Management?***

- Modeling for planning/policy purposes has been supplanted by modeling as an exercise
- Experiments seen as too expensive or risky
- Strong opposition to environmental policies by people protecting their self-interests
- Value conflicts within the community of ecological and environmental management interests, which are a barrier to changing policy

## ***Finally***

- **Is Adaptive Management appropriate for SDCP?**
- **Maintain system resilience**
- **Maintain a realistic time-frame**
- **Set realistic objectives based on available resources**
- **Have plenty of available resources**
- **Seek outside evaluation**





## **Considerations For Designing and Implementing Monitoring Programs**

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**Abstract:** Monitoring is quantifying one or more characteristics of a resource so that any changes in those characteristics through time (i.e., trends) can be detected in time to take management action. Because of the complexity and inherent variability in quantifying ecological resources, the success of a monitoring program depends strongly on its design. Therefore, principles of statistical sampling must be applied in the design of monitoring efforts to increase their efficiency and reliability. We suggest a series of steps for designing monitoring programs that are based largely on these sampling principles. The overarching objective in the design process should be to establish a sampling strategy that minimizes the effects of extraneous sources of variation while maximizing sampling efficiency and statistical power. Addressing the practical and statistical consequences of each design-based decision explicitly provides a framework for the design process and will increase the quality of monitoring efforts.

**Key words:** design, monitoring, sampling, populations, statistical power.

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Information gained by carefully designed population monitoring programs will become increasingly valuable to natural resource decision-making and conservation planning. Assessing natural and anthropogenic effects on natural resources depends on reliable information about trends in resources over time and space. Monitoring also can provide information needed to estimate the effects of unplanned perturbations or management manipulations within the context of adaptive management. Despite the value of monitoring, programs with high statistical power can be costly to implement and challenging to design because of the myriad decisions involved in the design process. The greatest gains in reliability and efficiency, however, come during the design-phase.

Our objective is to provide a series of "steps" for designing population monitoring programs, to assess trade-offs and compromises in these steps, and to offer some general recommendations. These steps are delineated somewhat arbitrarily because most steps are interrelated. This interdependence highlights the importance of viewing each decision within the context of a larger design framework. Throughout the paper, we invoke the language of sampling and experimental design because this approach highlights the commonalities of all research designs. Addressing the practical and statistical consequences of decisions inherent in the following steps provides a framework for the design process and a foundation for further exploration of issues that can increase the quality, reliability, and success of monitoring programs.

## **Fundamental Considerations**

Management decisions, including those that influence the fate of a population or species, are usually made with incomplete and imperfect information. Increased understanding of the dynamics of natural resources will in turn increase the confidence with which we make these decisions. Subsequently, monitoring programs must be designed so that they have high likelihood of detecting biologically meaningful changes in target resources. Overarching goals in the design of monitoring programs, therefore, should be formulation of a set of realistic objectives, collection of data with high accuracy using methods that are proven and cost effective, and evaluating established programs with vigilance.

## **Steps in Design of Monitoring Programs**

All decisions made when designing monitoring programs interact to affect the strength, efficiency, and reliability of information gained during implementation. These decisions will focus on reducing extraneous variation (both natural and sampling) even though interest is in parameter estimates rather than variability. Consequently, the resulting program will represent a balance between practical challenges associated with meeting monitoring goals and sampling secretive organisms efficiently, and logistical and financial constraints. Before initiating the design process, however, sufficient knowledge of the ecology and life history of the species of interest, efficient methods to estimate population the characteristic of interest (parameters), and a basic background in statistical sampling methods are required to guide decisions.

### **1. Define goals and objectives**

The goal of most monitoring efforts is to detect changes and quantify trends in characteristics of natural resources. Changes can be defined as the difference in the value of a population parameter between two time periods (e.g., a 3% change in a parameter between yrs 1 and 5), and trends defined as continuing directional change in the value of a parameter (e.g., linear regression slope of -3.0 parameter units/yr).

In addition to trends, monitoring programs are sometimes designed to assess the effects of specific management actions and other planned impacts. In general, these designs fall more under the framework of research than monitoring, and are considered elsewhere (Osenberg et al. 1994, Underwood 1994).

### **2. Choose the species or group of species**

Virtually all natural resources can be monitored at any spatial and temporal scale. We will focus on vertebrate populations, which are a challenging group given their high mobility and complex behaviors. In general, species with higher densities and detectabilities are preferred for monitoring because collecting sufficient information on these species is easier and they respond more quickly to environmental changes. However, sampling variation for these typically small, short-lived species tends to be higher than for larger, longer-lived species (Gibbs et al. 1998).

Further, there usually is more concern about species that are rare or endangered species rather than species that are most amenable to sampling. Consequently, choosing a species or group of species to monitor involves balancing the degree of concern for a species, its amenability to sampling, its degree of habitat specialization, whether it is influenced by monitoring techniques, and whether results from monitoring might apply to other species in the region.

### **3. Select population characteristics**

Traditionally, abundance (or density) has been the parameter monitored most frequently, and usually investigated as changes in abundance over time ( $\lambda = N_{t+1}/N_t$ , where  $N_t$  is abundance at time  $t$ ). Other processes that determine abundance, such as survival and recruitment, can sometimes be more sensitive parameters, as future changes in abundance will be forecast by changes in these parameters. Population-wide parameters, such as age structure, can prove useful by reflecting changes in the population that may not be reflected in abundance. Community-wide parameters, such as species composition, also can be monitored effectively (Philippi et al. 1998) and in some cases provide relatively high power to detect temporal changes in vertebrate communities (Swann 1999). If uniquely marking animals is possible, the number of parameters and analytical tools available increases considerably.

### **4. Select a method to estimate population characteristics**

Whenever possible, choose an established, time-efficient method by which to measure the population parameter of interest. Most measures can be divided into two groups: *direct measures*, where the species being monitored is itself measured (e.g., density of beavers [*Castor canadensis*]), and *indirect measures* or *indices*, where some feature related to the species is measured (e.g., density of beaver lodges). If an index is used, it must reflect short-term changes in the population, have low variability, be cost-effective to employ, and provide a direct relationship to the true status of the population. Hence, the relationship between parameter and index must be established clearly. This relationship need not be 1:1, but, at a minimum, the sign of the trend in the index must correctly reflect the actual trend in the parameter over time. Failing to validate this relationship could yield results that fail to reflect precipitous changes in populations, leading to decisions that may endanger critical resources.

### **5. Define the sampling frame**

The sampling frame defines the area in which monitoring activities will occur and, importantly, defines the scope of inference to which the monitoring results apply. If an area is excluded from being available for sampling for any reason, results of the monitoring efforts will not be strictly applicable to this area. For example, if selection of sample units are restricted to areas within 1 km of a road, then areas beyond 1 km are no longer part of the frame and valid inferences to these areas cannot be drawn. Boundaries of the frame should be established based on monitoring goals and logistical practicalities.

## 6. Develop a sampling strategy

If resource characteristics could be measured without error for the entire population of interest, then sampling would be unnecessary. As this is usually impossible, monitoring programs must employ sampling across space and time. Decisions are usually considered at two spatial scales: *sampling design*, which defines the method by which sample locations are chosen (i.e., the portions of the frame actually monitored), and *plot design*, which defines the size, shape, number, and spatial arrangement of plots at each sample location (Scott 1998). Before sample units are selected, the area to be sampled is usually divided into units that cover the entire sampling frame and define the region about which you wish to make inference. Temporal decisions about the frequency of sampling and resampling are addressed below.

*Replication*—A replicate in most monitoring designs is the fundamental sample unit. Replication is important because it increases the validity of research efforts by distinguishing “treatment” effects from all other effects, which in monitoring involves distinguishing changes in population parameters over time from changes due to other sources. Replication is important because it demonstrates that observed trends are consistent among sample units, reducing the chance that a trend occurred due to chance; it increases the precision of parameter estimates; and it provides an estimate of error, the variation among similar sample units, which in turn provides the basis for assessing the results of the monitoring program statistically.

*Reduction of Error*—Design of monitoring programs should focus principally on reducing extraneous sources of variability. By recognizing and accounting for these sources of variability, precision of parameter estimates is increased as is the ability to detect real trends. Ideally, a sampling design would account for all known sources of variation that affect the parameter measured, even if the variability itself is not of interest. If known sources of variability are not incorporated into design, they become part of error and decrease the power of the monitoring program.

All approaches to reduce error share the goal of increasing precision of a sampling design. In addition to the obvious benefits of refining the measurement technique and providing sufficient training in field methods, the most common approaches include restricting the sampling frame, stratifying samples into homogeneous groups, and measuring concomitant information. If sample units vary greatly with regards to the measured population parameters, then error variance among units will be high. By restricting sample selection to one or a few homogeneous strata, this variation is minimized. For example, if the target species inhabits 3 distinct environments and densities differ among environments (assuming density is monitored), then differences in density among sample units becomes part of experimental error. The simplest way to reduce this type of error is to sample only one environment, realizing that the scope of inference is now restricted. A related approach involves stratifying sample units into homogeneous blocks. If you expect the density of the target species to differ among environments (strata), first delineate each strata, then select samples at random within each strata. Although strata will differ with regard to the parameter of interest, the statistical analysis used will account for that variability and focus on the relative temporal changes in a population

within each strata (Nickerson and Brunell 1998). Lastly, an approach that is functionally equivalent to stratifying on every sample unit is to measure concomitant information (covariates) related to the parameter of interest. If density estimates are affected by rainfall, for example, including the amount of rainfall per sample unit as a covariate in the analysis will effectively remove the effect of rainfall on density. This step will increase the precision (and statistical power) with which the temporal trends about the response variable of interest are examined.

### **7. Select sample units**

Units to sample are best selected at random rather than haphazardly or systematically. This eliminates bias by ensuring that no potential sample unit is favored over any other, and will ensure independence among units, a requirement for valid statistical tests. Any system of selecting samples that yields units that are more or less alike than expected by chance will result in variance estimates that are smaller or larger than expected.

There are many methods by which to select sample units from those available, and each offers advantages and disadvantages. *Systematic* sampling eases sample selection and provides good spatial dispersion, but makes no effort to eliminate potential biases. When the sampling frame is homogeneous, *simple random* sampling, where every sample has an equal probability of being drawn, is typically used. When the sampling frame is heterogeneous and has been divided into nonoverlapping strata, *stratified random* sampling, where samples are drawn at random from within each strata, provides a gain in precision (i.e., a reduction in error). In extensive monitoring programs, efficiency can be increased by grouping sampling units into clusters (Scott 1998). In *single- and multi-stage cluster sampling*, clusters of samples are chosen rather than individual sample units. Although units within a cluster are not strictly independent, these methods can be beneficial when the cost of measuring units increases as the distance separating sample units increases. These and other useful sampling strategies are detailed in sampling texts (e.g., Thompson 1992, Scheaffer et al. 1996).

### **8. Establish sampling frequency**

Sampling units should be measured at a frequency that reflects the population rate of change, the degree of precision required, and funding availability (Scott 1998). Measurement frequency should be greater in systems with higher variability and where monitoring will take place over shorter periods of time (Gibbs et al. 1998). A decision related to frequency involves whether to sample the same units every year, sample new units every year, or some combination of both. Sampling the same units every year (permanent plots) increases precision because spatial variation is reduced (Green 1989); however, monitoring results then depend only on the initial units selected and whether that sample was representative. Sampling new units every year is efficient for estimating values within that year; however, estimation of temporal changes is inefficient relative to sampling permanent plots (Schreuder et al. 1993). Sampling with partial replacement (using both permanent and temporary units) has advantages of both previous alternatives, although planning and parameter estimation is more complex (Scott 1998).

## 9. Determine sample sizes

The number of units necessary to reach the goals of a monitoring program can be estimated based on a chosen level of precision for the relevant population parameters or a chosen level of statistical power. Both approaches are useful and related, but I find it more intuitive to consider a desired level of power rather than a desired level of precision. Power analysis provides a useful framework for evaluating the effects of alternate design changes on the number of sample units that need to be monitored to meet program goals. Introductions to employing power analysis for monitoring exist in the literature (e.g., Green 1989, Gerrodette 1987, Nickerson and Brunell 1998) and on the Internet (<http://www.mp1-pwrc.usgs.gov/powcase/powcase.html>). Software for computations is also increasingly available (Gerrodette 1993, Gibbs et al. 1998).

Statistical power analysis is based on the framework of statistical hypothesis testing, and power is defined as the probability of correctly rejecting a null hypothesis that is false. For many monitoring programs, the most common null hypothesis is one of no biologically meaningful trend in the population parameter. Power is determined by the number of sample units monitored, the variability of those units, the choice of what represents a "biologically meaningful change" in the parameter monitored (i.e., effect size), and  $\alpha$ , the rate of Type I errors, which is the probability of incorrectly rejecting a null hypothesis that is actually true. You can solve for the number of sample units necessary to meet monitoring goals by estimating or establishing values for power, effect size, variance, and  $\alpha$ .

Estimates for variance are best obtained from a pilot study but can be estimated from the literature or previous work if necessary. Establishing levels of  $\alpha$  and power (power =  $1 - \beta$ , where  $\beta$  is the rate of Type II errors, or the probability of incorrectly failing to reject a null hypothesis that is actually false) requires balancing the costs and consequences of incorrect results. In most monitoring settings, the consequences of concluding there is no trend in the population when indeed there is one (making a Type II error) may be more severe, so I suggest establishing  $\beta \leq \alpha$ . For example, if  $\alpha$  is set to 0.20,  $\beta$  would then be set to  $\leq 0.20$ , requiring the power of a program to be  $\geq 0.80$ . Perhaps the most challenging step in this process is to establish the minimum biologically meaningful level (or levels) of change you wish detectable by the monitoring program (effect size). These can be stated as either absolute effects (density decreases of 50 individuals over 10 yrs) or relative effects (density decreases of 5% over 10 yrs). In general, the sample size necessary to meet a fixed level of power decreases as the true trend in the parameter monitored deviates from the null hypothesis (effect size), decreases as the precision and extent of data increase through time, and increases as  $\alpha$  decreases. Finally, when establishing the number of sample units to monitor, consider the possibility of sample units being lost or destroyed during the life of the effort.

## **10. Allocate samples**

Having established goals, a sampling design, and the sample sizes necessary to meet program goals, you must determine how many units to allocate to each strata. This decision will be guided by differences in size, variability, animal density, and sampling cost within each strata. In a given stratum, increase the number of samples if a stratum is larger, a stratum is more variable, and sampling is cheaper within a stratum. Appropriate allocation formula are available readily (Thompson 1992).

## **11. Choose an appropriate statistical model for analysis**

The statistical model used for data analysis must be consistent with the sampling design, and must incorporate effects of other variables that may be confounded with the measured parameter and other influential factors such as observer bias (Link and Sauer 1998). Power will be lost when an inappropriate model is used for analysis (Hatfield et al. 1996, Steidl et al. 1997).

## **12. Evaluate and revise**

Incorporating periodic evaluation of monitoring programs is invaluable. After each sampling period, ways in which the current design might be improved given the newly acquired information should be investigated. The power of the program to detect a range of biologically meaningful effects (or the rate at which confidence intervals on parameters capture these effects) should be calculated, and important sources of variability not previously considered should be incorporated into the sampling design. If necessary, sample units should be reallocated.

## **Recommendations**

Most general monitoring programs are inherently long-term propositions, requiring a minimum of 10 or more years to detect trends in vertebrate populations (Hatfield et al. 1996). Hence, a genuine commitment of monetary resources must be made in concert with a realistic time-frame and a realistic set of program goals. With a commitment and draft sampling design, seek the advise of a statistician as well as peer review before embarking on such as project, as subtle changes in sampling design can yield demonstrable effects and consequently improve the reliability of the decisions made with these data.

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# *Adaptive Management and Multiple Species HCPs*

**Paul Fromer**

**RECON**

**June 30, 2001**

# **Legal/Regulatory Sources**

- **The ESA**
- **USFWS HCP Handbook**
- **Additional Policies**
- **Precedents**

## **ESA: Section 10(a)**

- **Conservation plan must specify:**
  - ✓ **Impact of taking**
  - ✓ **Steps the applicant will take to minimize and mitigate ... and the funding that will be available...**
  - ✓ **Alternatives**
  - ✓ **Such other measures...necessary or appropriate for purposes of the plan**

## **ESA: Section 10(a)**

- **The plan must ensure:**
  - ✓ **Taking will be incidental**
  - ✓ **The applicant will...minimize and mitigate the impacts of...taking**
  - ✓ **Adequate funding**
  - ✓ **Taking will not appreciably reduce the survival and recovery in the wild**
  - ✓ **Other necessary measures are met**

# ***USFWS Policy Guidance for Adaptive Management***

- **Endangered Species: Habitat  
Conservation Planning Handbook  
(November 1996)**
- **Addendum to the HCP Handbook  
(May 2000) “the 5-point policy”**

# ***Adaptive Management***

- **Purpose**
- **Conservation Strategy**
- **Role of Research**
- **Role of Monitoring**
- **Initial Assumptions**
- **Corrective Actions**

# **Purpose**

- **Minimize uncertainty from gaps:**
  - ✓ **Scientific data**
  - ✓ **Biological requirements**

# ***Conservation Strategy***

- **Define biological objectives or goals**
- **Model ecological system**
  - ✓ **Components**
  - ✓ **Interactions**
  - ✓ **Natural fluctuations**
- **Allow changes in management**
- **Ensure likelihood of survival and recovery in the wild**

# ***Role of Research***

- **Fill gaps in initial information**
- **Test effectiveness of management**
- **Provide means for assessing minimization and mitigation**
- **Produce better ecological knowledge**
- **Develop appropriate modifications**

# *Role of Monitoring*

- **Ensure proper data collection, analysis, and use**
- **Establish testable hypotheses linking**
  - ✓ **Conservation strategies**
  - ✓ **Biological objectives**
- **Define “thresholds”**
  - ✓ **Linked to key criteria**
  - ✓ **Measurable**

# ***Initial Assumptions***

- **Agreement as to range of potential adjustments**
- **Mechanism to determine magnitude of adjustments**
- **Based on monitoring**
- **Developed in advance**

# ***Corrective Actions***

- **Based on significant “non-achievement” of mitigation**
- **USFWS will work with applicant to compensate for external factors**
  - ✓ **Develop strategy**
  - ✓ **Voluntary increases in base mitigation**

# *The 5-point Policy*

- **Focuses on expansion/integration of:**
  - ✓ **Biological goals**
  - ✓ **Adaptive management**
  - ✓ **Monitoring**
  - ✓ **Permit duration**
  - ✓ **Public participation**

# ***Biological Goals and Objectives***

- **Commensurate with the scope of action**
- **Broad guiding principles for plan**
- **Rationale behind minimization and mitigation strategies**
- **Objectives are measurable targets for achieving goals**
- **Integrated into operating HCP**

# ***Adaptive Management***

- **An integrated method for addressing uncertainty**
- **Used to examine alternative strategies for meeting biological goals and objectives**

# **Monitoring**

- **Provide assurances**
  - ✓ **compliance**
  - ✓ **gauge the effect and effectiveness of the HCP**
- **Inform choices under adaptive management provisions**
- **Assist in redefining biological goals**
- **Provides data for range-wide assessment**

# ***Monitoring Program Characteristics***

- **Flexible**
- **Comparable spatially and temporally**
- **Respond to outstanding questions**
- **Reflect biological objectives'  
measurable units**
- **Based on sound science and  
standard survey protocols**

## ***Permit Duration***

- **In part, duration depends upon:**
  - ✓ **Extent of scientific data underlying HCP**
  - ✓ **Length of time necessary to implement and achieve benefits**
  - ✓ **Extent to which HCP incorporates adaptive management**

# *Precedents*

- Reflect the evolution of HCPs
- Embodied in the handbook and 5-point policies
- Limited by uniqueness of each plan context
  - ✓ Biological
  - ✓ Political
  - ✓ Economic

# *Adaptive Management and Multiple Species HCPs*

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