

SECOND BIENNIAL STATE OF TOMALES BAY CONFERENCE
Oct 6, 1990

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1990**

AGENDA

October 6, 1990
10:00 AM to 7:00 PM

- 10:00 Registration
- 10:20 Introduction: Michael Ellis, Moderator
and The Honorable Peter Behr
- 10:40 Tomales Bay Herring Fishery in Decline?
Tom Moore, Calif. Dept. Fish and Game
- 11:20 Tomales Bay Oyster Industry
Lisa Jang, Bay Bottom Beds Oyster Co.
Dr. Douglas Price, Calif. Dept. Health Services
- 11:50 California Mussel Watch
Dr. Michael Martin, Calif. Dept. Fish and Game
- 12:50 Lunch: Provided
- 1:30 Watershed Restoration
Steve Chatham, Prunuske/Chatham
- 2:00 Preventing Animal Waste from Degrading Water Quality
Dr. Rick Bennett, U.C. Cooperative Extension
Joe Mendoza, Rancher
- 3:00 Break: Refreshments
- 3:15 Freshwater and Sediment Inputs into Tomales Bay
and Comparisons to Other Estuaries
Philip Williams, Philip Williams Assoc.
- 3:45 Panel Discussion:
Guest Moderator, The Honorable Robert Kroninger
- 4:25 Concluding Remarks: Assemblyman Dr. William Filante
- 5:15 Dinner: Tomales Bay oysters, barbecued lamb and albacore
- Edited by** Richard Plant, and Michele Morris, and Judy Simmons

Editors' Note

Sections of this document were first tape recorded, then transcribed and edited. They represent an effort to capture the portions of the conference that were not submitted in writing in advance. We have taken liberties to try to improve the grammar or the syntax where the tape recording was not clear. The reader should verify the accuracy of any important issues with the original speaker.

Conference Steering Committee

Carl Munger

Margaret Graham

Richard Plant

Ellen Rilla

Bruce Wyatt

Don Neubacher

Financial and In-Kind Aid

County of Marin

Inverness Foundation

Tomaes Bay Association

Environmental Action Committee of West Marin

Marin Community Foundation

University of California Cooperative Extension

Point Reyes National Seashore

West Marin Paths

Appendix 1

Introduction

Michael Ellis, Moderator

We can only fantasize or imagine what Tomales Bay might have been like prior to the Europeans colonizing this area. What we do know is that there was a very healthy vibrant population of coastal Miwok Indians living along the shores of Tomales Bay. And they had been living here for maybe two to three thousand years. And it really must have been a veritable Garden of Eden. We learn from the early descriptions of explorers in the area that the wealth of wildlife was incredible. In the winter time, literally hundreds of thousands of waterfowl stayed in Tomales Bay. The sky must have darkened as they flew over. The steelhead and the salmon runs up to Papermill Creek were so thick you could walk across the backs of these fish (a little bit of an exaggeration). Huge herds of tule elk and mule deer, and grizzly bears were roaming this area. Bear Valley was not named for the black bears but rather for the grizzly bears that were here. I've been in grizzly bear country, and it makes taking a nature walk a totally different experience, knowing that nature can eat you while you're out walking around! There were mountain lions, bobcats (we still have these), and coyotes (which are coming back). And of course, the rich eel grass and the mud flat areas produced a cornucopia for the residents. It must have been a relatively easy life here.

All that changed with the arrival of the Spanish, whose cattle grazed on the frail grasses. Erosion increased. After the Gold Rush of 1849, a tremendous logging boom occurred across the Tomales Bay watershed, which I believe Steve Chatham will probably discuss later. Then came the advent of the potato farmers. All of these three changes in the last century did a lot to increase the sedimentation and silt at Tomales Bay.

Nevertheless, we have a tiny remnant of that jewel still left and it is really a priceless heritage. Tomales Bay is a special place. It was given national recognition by its inclusion in the Gulf of the Farallones National Marine Sanctuary. And last year the United Nations recognized it and included it in their Biosphere Reserve system. So these are areas of worldwide biological significance here in our backyard. But sometimes appearances can be deceptive. That is what this conference is all about. We've gathered together a number of scientists, whose careful research is looking into the real state of the health of Tomales Bay. This event today is a forum for scientists to share their information with the general public. And that is what we hope to continue to do because scientists, as they will probably agree, live in a somewhat isolated world. And the connections between what they're doing and what they're studying and the guy walking down the street are not always made. That is why these topics covered today and these arenas are so important.

Next I would like to introduce the Honorable Peter Behr. He's a former County Supervisor for Marin County, a former State Senator, the chairman of the Tomales Bay Advisory Committee, a resident of Inverness, an ardent conservationist, and my friend. Let's give him a hand.

Introduction

The Honorable Peter Behr

I want to go back to the last conference two years ago and start with a quote (because it's easier to quote than to think). I'm quoting from Michael Josselyn who said this, " I recommend that we recommend a Tomales Bay interagency task force modeled after the one established for Morro Bay in San Luis Obispo County. Such a task force would bring agencies together with the public to establish management goals for the Bay. It would also serve to identify the research needs and, hopefully, focus the funding necessary to accomplish the goals and needs."

That was the genesis of the Tomales Bay Advisory Committee (TBAC), which is under the aegis of Senator Milton Marks and sponsored by a committee of the Senate - the Natural Resources and Wildlife Committee. The Advisory Committee has been alive since shortly after the conference of October, 1988. The first meeting was in February of 1989 with Senator Marks. The committee met four times in 1989 and three times in 1990 (on a quarterly schedule). What the committee has done is put together a group that meets every three months at the National Headquarters of the Seashore. The group focuses on the problems of Tomales Bay. It is meant to be broad-ranging, including local organizations, local industry, and county, state, federal people, all of whom have had a stake in the Bay and affect its future.

Among those who receive mailings of our minutes is Steve Eabry, who is in charge of the Morro Bay Task Force. And since that Task Force has done such an exceptional job, and since they invited me down there to talk, and since Steve has been helping me too, if he could be recognized, I'd appreciate it.

You'll be pleased to know that the Tomales Bay Advisory Committee has been meeting to discuss various problems. The Committee consists of people all involved in some way with the Tomales Bay watershed who seek to form of a management plan which the Bay needs. We have sought consensus. We have emphasized local concerns and the problems which threaten the health of the Bay. We need scientific research as a bedrock - a foundation for this management plan to grow up and rise. The problems which most of us know about include freshwater inflows, sediment input, pollution from dairy waste, and effluent from Santa Rosa in the Estero Americano (which presently is the greatest single threat the Bay has faced for as long as I can remember). Whatever plan we arrive at, for the sake of a holistic approach, we must look down on the Bay like an eagle overhead, observing all its various parts and how they interlock.

Of course, the management plan must be enforceable. In my judgment, this will take special State legislation after the plan has been put together. The plan must meet with the general approval of all the groups that live near and about the Bay, because if it doesn't, it won't work. There are few things worse than a law which is on the books and doesn't work. So we have the dairy ranchers, the environmental organizations, as well as the landowners, the oystermen, the yachtsmen and so forth represented. And when I say the

plan must be enforceable, I mean that there has to be someone with the authority to enforce it, which means that it's just not enough to put one more plan into operation and get it on the books. After spending eight years in Sacramento, I realized that the bookworms eat the books before the books are published!

I'm pleased to be here. I'm pleased to talk with you. I'm anxious to get around to the other peoples' talks. You've been an attentive audience. I think we have a lot to look forward to and learn about. And thanks for listening.

Joe Mendoza, Rancher

Introducing Dr. Rick Bennett

Good afternoon. For those of you who don't know me, I'm Joe Mendoza, Jr. I'm a third generation dairy rancher. First of all, I happen to be the chairman of the Marin County Dairy Waste Committee. And I'd like to explain a little bit about what that committee was formed for and what it tries to do. Initially, in the 1960's and early '70's, we became aware that water quality was going to be an issue. It was apparent that in order to stay in business and continue in the dairy industry, we would have to face this issue and try to educate ourselves and head off some of the problems.

Our Committee tries to act as a mediator between the various water quality agencies, such as the Department of Fish and Game, and the dairies. When a complaint is made, I'm usually notified. One of the Committee members will then go out and speak to the individual concerned. One of the first things we try to do is get the engineers out to look at the situation to see what can be done to improve it. Normally, the individual involved is cooperative. The ranchers generally feel easier talking to someone they know and then we all try to solve these problems together.

We're very fortunate to have a fine Resource Conservation District staff. There's Rick Bennett and quite a few others who really try to help the ranchers remediate these problems. But we also try to head some of them off before they happen. So we've had various seminars, and mailers going out to inform about types of management practices. We're trying to educate our dairy ranchers and prevent some of these troubles as much as we can.

The industry has changed some. There aren't nearly as many dairies as there used to be when I was starting in this business. There are now only about 60 in Marin County and about 120 in Sonoma County. If you go back 20 years, you could probably double that. There are fewer dairies, but there are more animals per dairy. In addition, the animals are confined more for the purpose of getting more production. We've got a lower price today than we had eight years ago for our product. So we've been forced to get more efficient. The cows are confined more, milked three times a day, for example, to improve efficiency.

But this means that the dairies have to have better facilities for containing the waste, which has put added pressure on the industry. Engineers are designing waste containment systems but the costs bring about economic strain. However, we're encouraging our dairy ranchers to make these investments. We also have the Agricultural Conservation Stabilization office (which, hopefully, we can keep open) in Santa Rosa, which helps fund some of these investments. They pay for part of the costs of installing new facilities. And I hope that people are interested in keeping Tomales Bay clean. We encourage Barbara Boxer, or whoever, to get us in the budget to assist us in our goal of keeping the water clean.

Now, I'd like to introduce Dr. Rick Bennett. He's the dairy farm advisor for Marin County and Sonoma County. We're very lucky to have a man in this position with the experience and education that Rick has. He is internationally renowned for his research into mastitis (which is when a cow's udder gets infected). Rick has really taught us all a lot and has helped us with improving our efficiency. He also works hard in helping me and others in our work on this water quality problem. Here's Dr. Rick Bennett.

Appendix 3

Freshwater and Sediment Inputs Into Tomales Bay and Comparisons to Other Estuaries

Philip Williams
Philip Williams and Associates

Well, I've been asked to talk about freshwater and sediment input on Tomales Bay as if I were a great expert on the subject. Unfortunately, that really is not the case. My research and involvement with Tomales Bay is pretty much limited to this report. I don't know if many of you have seen the Coastal Conservancy Report which was done 8 years ago, but I've been a very interested observer of changes that have come on in the watershed here.

Having disqualified myself as an expert, I will now qualify myself as a speaker, because I think it's fair to say that there isn't anybody who is expert on the sediment hydraulics and hydrology of Tomales Bay. And really, that's my first point. These extremely important topics dealing with the research and management of Tomales Bay have not been covered adequately and they really do need to be. I think understanding the physical processes that affect the Bay, the physical evolution, the hydrology, and the hydrodynamics of the estuary underlie any research program and any attempt to come to management decisions.

So what I want to do today is actually draw on some of my experience on other estuaries, explain some of the management issues we've been dealing with there and then talk more specifically about some of the physical processes that are going on in the Tomales Bay watershed, and how they are affecting Tomales Bay, and how they may relate to management decisions.

I'm going to start off specifically by dealing with the important management issue of fresh water inflow. (Pointing to slide) This is Tomales Bay a few days after the 1982 floods. You're looking down the Bay and you can see two patches of light water - that's fresh water coming out of Walker Creek and Lagunitas Creek. So clearly, we know that fresh water inputs, whether as large flood flows or as summer flows, can have an appreciable effect on what happens in the Bay.

I'm very well aware of the management question of how much fresh water flow is really required for the flow of the estuary. We're in the very early stages of doing research to answer some of the questions and to understand some of the linkages that are important in making a determination. I want to explain a few things about how we address the simple question related to how much fresh water inflow San Francisco Bay needs. If anybody wants a good overview paper on that, Mike Josselyn wrote an article in *Waterfront Age* on that question about a year or so ago.

To refamiliarize yourself with San Francisco Bay, it is an estuary far larger than Tomales Bay. And the watershed is far larger. We've experienced substantial declines in the key resources, salmon and striped bass, at the same time that diversions of fresh water from

the estuary have been increasing over the last 30 years or so. And there is really a very dramatic question in that we know that when water projects were constructed in the watershed of San Francisco Bay in the Central Valley, there was no consideration given to potential impacts downstream on the estuary. This is a new problem which is emerging and a new constraint needs to be imposed on the management of water resources in California.

A graph like this, while very important in indicating changes in resources, is not really satisfactory as a basis for making management decisions because it treats the estuary just purely as a black box. You can do correlations of fresh water inflow and decline in resources, but you're never going to really be able to address some of the key questions such as, are you really identifying the causative factors that cause salmon and striped bass to decline? You have to go beyond that. I was foreseeing in Tomales Bay, the possibility of developing the same sort of linkages that we were able to establish in San Francisco Bay.

The first thing that you look at is how much the flow has changed in an overall sense. Just to give you an idea of the scale of changes that have occurred in San Francisco Bay, the water projects divert 50% of the fresh water runoff. That will increase in the future. But again, that's not a satisfactory way of characterizing the changes. You have to look in more detail about how the flow into the estuary has changed. And what you have to do in order to develop clear linkages between natural resources and changes in the hydrology is establish how the changes in hydrology affect the hydrodynamics of the estuary, and how the hydrodynamics of the estuary affect the ecosystem dynamics. Then if we can establish these clear cause and effect linkages, we can be confident, when attempting to manage the resource, that we need to make changes in the hydrology, in other words, not divert as much water.

For example, we see in San Francisco Bay, under natural conditions, there are two peaks in the natural hydrograph - in the winter and in the spring. We see that under present conditions there is only one peak. In other words, the peak of spring snow melt runoff has been eliminated in San Francisco Bay. And yet, we now know from research we've done on San Francisco Bay that the spring flows in San Francisco Bay are very important for various components of the ecosystem. And the work of Tim Hollibaugh in the area of defining phytoplankton productivity, clearly linked the productivity to the position of the entrainment zone in the estuary and also to stratification of the water column. The fresh water moving in over salt water allows phytoplankton blooms to develop.

But when we can start seeing how these particular changes in hydrology affect the ecosystem dynamics, then we can start turning around and saying that we now know enough to ask for more fresh water flow at certain times of the year. So, this, again, is the kind of approach that I foresee coming down the line on Tomales Bay on some of the issues that we're dealing with here.

Now, just looking at some other aspects, I know we have someone here from Morro Bay. Tomales Bay is not really unique in California. Many of the other estuaries are experiencing similar management problems. Morro Bay is a good example. There are

fresh water inflow issues there. But also, what is more common actually is sedimentation. Long term significant changes occur in many of the estuaries in California with increases in sedimentation filling up the estuaries. This has tremendous ramifications for our coastal resources.

Another example, is Tiajuana Estuary where so much sedimentation has occurred that the entrance channel to the estuary is in danger of closing during storm events. And this is one of the National Estuarine Research Preserves. The entrance channel closed for a year in 1984. It had a substantial effect on the ecosystem of the estuary. And in some cases, for instance like here on Baraquitas Lagoon, so much sedimentation occurred in the lagoon that the entrance channel is now permanently closed. You transform an estuary or a lagoon into what can become a salt pond or a hypersaline lagoon in the summer.

The long term changes are very important in the future of the estuary. How does this apply to Tomales Bay? Everybody who was here around 1982 can remember that dramatic things were happening - houses were being washed down into the Bay, huge mud flows, and so on. In fact, the '82 flood was a kind of reminder of how dynamic the physical system is, i.e. the watershed here. The 1982 storm was not unprecedented. It was an extreme storm, but there have been many storms like that in the past. It caused a number of mud flows. If you trace the course of this very large flood, you can see how the natural system operates. A lot of sediment was produced during the flood. Much of the coarse sediment, if it comes down into the lower part of the creeks, gets deposited on flood plains. That's how flood plains are created, mud terracing over with time. The water was still very turbid several days after the peak flood with not only coarse sediment, like sand carried by the water, but with very fine sediment that was washed down into Tomales Bay.

Farther downstream, where these creeks meet tide water, is where the bedload, the material like gravel or sand that is carried along the bed of the creek, will tend to be deposited. And right here in this picture (this is just below the Highway One bridge) you see huge banks of gravel deposited after the '82 flood. But on the smaller tributaries, you can get a very good idea of the dramatic changes that can occur from just one big flood which brought down large amounts of sediment and created this large band of sediment in Inverness immediately after the 1982 flood. One advantage of the 1982 flood was that everyone was concerned about sedimentation immediately after it occurred, as it was so dramatic and visible. But what tended to happen was that after the big flood was over, people forgot and went back to their everyday business.

But the processes continue. Steve Chatham showed you some much more dramatic photographs of the process called "arroyo formation" which is occurring in the watershed of Tomales Bay and having dramatic effects on the sediment inputs. An arroyo is a stream channel that has become unstable. The reason it becomes unstable is due to increased runoff caused by grazing of the watershed, and the grazing of the riparian corridor reduces the resistance of vegetation to flow velocities. The combination of events will enable a stream to start scouring at much greater force than it does naturally. Once that process is initiated and a stream channel starts downcutting, tremendous changes occur in the stream forces. It delivers very large amounts of sediment. The

whole character of the stream channel changes. This is a change that has occurred particularly over the last hundred years or so.

Steve read you the account of the grazing land characteristics of West Marin County in the 19th century. And that was largely due to the grasses in the watershed. It's very hard to find examples of those grasses anymore. But I was able to track one down because Skip Schwartz (of Audubon Canyon Ranch) mentioned to me that adjacent to the Cypress Grove marsh there was a piece of land that has been fenced off from grazing for at least 10 years. And in this piece of land you could see the native bunch grasses coming back and growing up higher than the fence posts. When you walk through this and look down, it's as if you're walking on a mattress. You can imagine how different that is in terms of how it effects the hydrology of the stream flow. When water lands on this surface, it's not only retained by all the roots, but the runoff is much slower. It releases more water in the summer, so the winter flood flows are not as large and summer flows are larger. The hydrology of the streams under the original conditions of Tomales Bay watershed was substantially different than it is now with the annual grasses frequently overgrazed, resulting in exposure of the soil to runoff.

You can also see this farther downstream on Walker Creek, for example, where the riparian vegetation along the creek channel has been extensively eliminated. Further downstream the coarse sediment tends to be deposited immediately at the mouth of the creeks. But the finer sediment is conveyed all the way into the estuary. Understanding the dynamics of fine sediment and coarse sediment is very important to understanding the evolution of the Bay.

Slide: Take a look at how the Bay has changed over time, looking first at the 1862 map. I want to point out a couple of things here. I've got another slide with the shoreline colored in. I wanted to show how far the estuary extends upstream. You can see the bend right here. And you see that little bay up there on the left? That's just about where Inverness is. Now, the important thing about it is that there is a bay there. And, not only there, but on the mouth of all the other little tributaries along the shoreline of Tomales Bay you see indentations. What this means is that over the last thousand years or so the Bay has evolved by sea level rising. And rising sea level has been greater than sedimentation. In other words, sea level has dominated over sediment delivery from these streams. So that's why you get these little indentations at the mouths of all these creeks.

Now you can start looking at how it changed. You can see the advance of the delta of Lagunitas Creek at the time (1954). And then when you go to the present (1987), you can see that the delta has advanced more up over Tomales Bay. And you can see that the mouths of all the creeks, instead of being indentations, are now deltas projecting out into the Bay. So now, sedimentation is dominating over sea level rise. So there's been a significant shift in processes affecting Tomales Bay on a long-term basis. And the huge increase in sediment delivery, has had a number of very important management implications.

First, let me just summarize what these impacts are. When you have such dramatic changes in the watershed, you have not only enormous amount of sediment delivered to the stream courses, but the productivity of the land declines as you lose the soil and you lose the longevity of the period where the grass stays green until September. You lose the habitat. The creeks have changed so dramatically by downcutting, that they become gravel dry beds in the summer. Whereas, before, they would have been shaded perennial streams. So you lose fish habitat there. The summer flows are reduced and there's a degradation of habitat. Riparian vegetation is lost. Water quality is deteriorated, due to its exposure to the sun in the wide, shallow sediment-filled shallows. Winter flood flows are increased because, whereas before floods spread out over the flood plain, now they're all contained within the arroyos. And they just shoot downstream eroding the banks. So you have dramatically changed flood flow.

Then, also, there is a dramatically increased sediment delivery to the estuary which translates into reduction of the surface area of the estuary and the filling or smothering of marshes with sediments. There's a loss of navigation and an overall impact on the ecosystem which we don't really know about yet. The Walker Creek Delta is an area where ships used to go up Walker Creek in Tomales - it's now extending into Tomales Bay. Here you see Cypress Grove Marsh which is now acting as a great sediment basin, catching sediment which would be going into Tomales Bay, but it's causing problems for the Cypress Grove Marsh. And here is how navigation is being affected by the progressive shallowing of the mud flats of Inverness.

I'd like to continue on why we need to get a better fix on some of the physical changes and physical processes effecting Tomales Bay and how they could affect management decisions by using examples of a specific location. Having read the Coastal Post and the Point Reyes Light, I know this example is a very controversial one. And that is the question of the potential restoration of former marsh land on the Giacomini Ranch.

Here you see the area flooded after the '82 flood. Just to give you an example of what kind of things you would have to understand in order to make an intelligent decision about such an important management question, just take a look at these two photos: 1) Here's 1946, looking down Tomales Bay. This, in the foreground here, is just after this land had been levied off. 2) And this is how it looks now. You can see the progression of the delta into the estuary. But the important thing to note in the 1946 slide was that this upper part was the natural depositional area for Lagunitas Creek - so sediment would deposit in this area. Now what that means is that if you were to consider restoring that to a wetland, that, too, would be a problem because if you have sediment dumped on a wetland, it will convert it into an upland.

In one of the restoration projects I've recently designed, in Wildcat Creek, we put in a levy along the edge of a wetland here to prevent sediment coming out of the creek and being discharged onto the wetland and smothering it. So understanding how much sediment is coming down and how the sediment is moving through the system is extremely important.

Another misunderstanding is that people think that restoring a wetland just simply means digging a hole in the levy. Well, you have to be very clear on what you want to get out of a restoration. Is it open water, which can be a valuable habitat for birds, or is it wetland vegetation? If you just simply dig a hole in the levy, you may end up with something totally different than anticipated. And in understanding how sedimentation occurs in a restored area, it is extremely important what the uptidal range is and how the physical system works.

I'll finish by just getting some perspective here. We're talking about processes occurring over a long period of time and we're not used to thinking in terms of a hundred years or so.

Slide: This, though, is a village in South Wales. It's most famous for being where Dylan Thomas lived and composed most of his works. You can see there's a Norman castle. And then to the left of the Norman castle you can see some very substantial buildings and warehouses from the 18th century which is the main supply depot for the East India Company. Now you can see right in front of it, the whole harbor is silted up due to man-made changes in the immediate area. So you see a situation where a system was stable for about 700 years but in the last couple of hundred years it's completely gone. And now this is almost like a ghost town, though it's a very pleasant place. So you have to think that man-made changes can make these shifts over these long periods of time.

To conclude, I want to draw your attention back to this report (The Coastal Conservatory Report), because in it, we summarized research and data needs for Tomales Bay. And this, though it was written 8 years ago, is just as relevant today. What we need to be evaluating is the sediment floodage of Tomales Bay. We need to know how quickly it is silting in and what are the prospects for the long term.

If things go on the way they are, is it going to be 200 years or 500 years before the entrance channel closes? We have a responsibility to address this now. With regard to the erosion mechanisms in the watershed, we need to be evaluating in a systematic way how this process works from the watershed down to the estuary. We need to analyze the hydrodynamics of the estuary in order to determine how the sediment moves within the estuary. And, very practically right now, we need to have a hydrographic survey on Tomales Bay. There hasn't been one since about 1950. And that, in itself, could be the most important data need for the present day.

QUESTIONS:

Q: After people recognize, in the Lagunitas watershed for example, that erosion is causing a problem, we have many people who want to go in and put in small check dams to catch the sediment as a solution to the problem instead of looking at the watershed and trying to hold the soils in place where they originally are. Could you comment on that a little bit?

A: I think we're dealing with acute problems and chronic problems. For acute problems you need to be putting in check dams. Overall, I think we need to be looking at how we can restore parts of the watershed to ameliorate some of the damages caused in the past.

Q: I know you referred to this, but maybe you could expand a little bit on the problems of compaction (i.e. from grazing) and associated runoffs.

A: I think that is certainly a contributing factor. But I think that compared to some of the other changes that have occurred in the watershed (for instances, just the change in grasses), on the total area of the watershed, compaction may not be as significant as some the other factors. On a strategic basis, if we found that the sedimentation in Tomales Bay is threatening the integrity of certain resources in the estuary, then we should look at how to reduce that. There are many strategies for doing so, and one of them could be range management and sowing some grasses. Another could be identifying specific sediment sources and dealing with those.

Q: My grandparents talked about how the bottom of the Bay was moved up from the earthquakes. And I've been told that an earthquake in the '60's moved some of the bottom of Drake's Estero. I suppose I'm throwing the question up for verification.

A: Well tectonic movements, obviously, are very important in creating the Bay. The question of how important they are in the long term, relative to sea level rise and sedimentation is not clear right now. It may well be that the type of movement you get in tectonic is an order of magnitude less than sea level rise.

Q: You mean to say that if we have another earthquake involving the San Andreas fault, it won't clear the Bay out?

A: Not necessarily. There was a part of Bolinas Lagoon that moved a bit in the 1906 earthquake - but only a small amount, just enough to kill off the pickleweed. It was maybe half a foot or so.

Appendix 2

Scientific Research On and Near Tomales Bay

Dr. Michael Josselyn
Tiburon Center for Environmental Studies

Dr. Chambers will be talking about the work being performed in Tomales Bay under a program sponsored by NSF (National Science Foundation), namely the Land Margin Ecosystem Research Program. He'll talk about that when I have finished my presentation on the evaluations that Tim Hollibaugh, Stephen Smith, and I did regarding the Estero Americano discharge plan.

So I want to talk a little bit about more about the NOAA study that we did as part of an evaluation of the impact of the proposed discharge on the Estero. I have to first state that neither Tim, nor Steve, nor I really did any detailed studies on the Estero, but we instead responded to the work that was being performed by the city of Santa Rosa, which has a very extensive field and evaluation program on the Estero. Our role was to provide review and advice to the National Marine Sanctuary, and to make our recommendations as to what we felt was occurring there.

As most of you know, the City of Santa Rosa is proposing to discharge treated effluent into the Estero Americano, and is coupling that with a number of "enhancement" aspects such as the improvement of the riparian corridor of Americano Creek and the removal of grazing activities within the wetlands of the Estero itself. As you know, grazing can cause a great deal of damage to the wetland habitat. In support of its conclusions or these proposed benefits, the city has prepared a number of technical memoranda regarding their evaluations on these various options. These memoranda were produced last fall and this spring. There were studies on bird populations in the area, studies on the wetlands and their distribution within the Estero, studies on nutrient loading, metal loading, studies on water circulation both in the Estero and offshore, as well as studies of the effects of the effluent and recommended discharge levels.

As a result of these technical memoranda, the city of Santa Rosa is recommending a discharge of treated effluent into the Estero in the amount of 7 cubic feet per second (cfs) during the spring and summer months, dropping to about 2 - 3 cfs during the fall and winter and, also, the exclusion of grazing from the wetlands. A third recommendation was nutrient removal (on the order of 90 to 99%) on the nitrogen entering the Estero, as well as some measures to reduce copper loading to the Estero.

So when we got the memoranda, we began renewing these recommendations. Tim Hollibaugh and I made a number of trips to the Estero, and Steve Smith and Tim took a number of samples. I don't want to say that we conducted extensive scientific research, but rather sufficient enough to satisfy ourselves with our work. We reviewed and provided the National Marine Sanctuary Service with our report on the Santa Rosa proposal. My purpose today is to briefly summarize some of our conclusions. What we provided was a very close scientific review of the issues, and I realize that for many of

you, they may go beyond what you can tolerate in an evening. So I'll go through some of the major issues that we feel are relevant to the project on a scientific basis.

In order to understand circulation within the Estero, a mathematical model was developed by consultants to the city of Santa Rosa. This model was an extension of one developed for the Stockton ship channel on the San Joaquin River, extending into the eastern portion of San Francisco Bay. As you might guess, we had some serious concerns about the applicability of a deep water channel model to the Estero Americano.

We think there's a misunderstanding. The Estero really is not an estuary. It's a coastal lagoon. It has a very shallow water nature. It doesn't have some of the same circulation patterns that you'd expect to occur in a deep estuary, like San Francisco Bay, where you do have differences in density from top to bottom. It doesn't have the same sort of circulation pattern attributable to the classic estuary. As a result of the application of that model, we felt there were perhaps statements about shifting of the maximum primary productivities within the Estero that really weren't applicable. In San Francisco Bay, there's a null zone where striped bass feed and there's extensive primary productivity that certainly is modeled by an estuarine model. But we don't feel that is applicable to the Estero Americano, and this was one of our criticisms of the plan that was proposed.

The second area of the plan that we looked at, based partly upon the model, was an evaluation of its ability to reduce, or the need to reduce, nitrogen loading to the Estero. Certainly, with high nitrogen loading, we could expect more algal blooms, we could expect greater turbidity in the water, and perhaps a decline in the benthic plants, particularly the eel grass. I think the consultants for the city of Santa Rosa would agree that excessive nitrogen in the Estero would result in poor water quality and algal bloom. However, the plan proposes to remove 90 to 99 percent of the nitrogen entering the Estero from the effluent. Unfortunately, there is no description of how that's going to be done except that it would be done within a wetlands system (a design that has not been finalized yet). So we had some very serious problems in trying to understand how the reduction of nitrogen could be achieved, which was necessary in order to reduce impacts of high nitrogen loading and of subsequent effects on turbidity and phytoplankton.

Metal loading is another issue that comes in with the effluent. Many of you have probably heard that copper is a problem with the effluent. It certainly could be a problem in the Estero. But we don't think that the evidence presented in the technical memoranda really demonstrated that copper was currently a problem in the Estero. In fact, there was insufficient data to reach that conclusion. One of the proposed benefits of adding more effluent to the Estero Americano would have been to reduce copper by diluting it. But we don't think the evidence is strong enough yet that copper is currently a problem in the Estero.

We also reviewed the findings of those technical memoranda relating to the impact on wetlands -the reports that evaluated the extent of salt water wetlands in the Estero and some of the problems associated with them. There's high salinity occurring within the wetlands, resulting perhaps in expansion of salt pans - that's barren areas. There's also the potential for the loss of vegetation, by the grazing activity, and of course erosion can

occur as a result of loss of vegetation. We think that those are all severe impacts as they're occurring now. We agree with the city of Santa Rosa in that regard.

The technical memoranda also found that there were large amounts of bird use in some of the salt marshes along the Estero, particularly in the upper areas, and that there were large fish populations within the channels, particularly in the upper Estero. Those were the areas to be most impacted by the proposed discharge of 7 cubic feet per second. And when we looked at what those discharges were, we had serious questions about the impacts of the conversion of salt marsh to brackish water vegetation, as well as the potential loss of the habitat for the fish and birds using those areas. We asked about or addressed those issues.

Now on to the subject of offshore impacts - what's going to happen as effluent moves through the Estero offshore? Tim did quite a bit of analysis and looked at the data that was provided. Unfortunately, there's not a very good study for offshore impact. Santa Rosa relied on data from the PG&E plant proposal for Bodega Head and we feel that's really not appropriate for Bodega Bay, so that's one of our stronger criticisms. The circulation within Bodega Bay is such that perhaps the effluent loading would be in lighter density water and would sit on the surface and might result in increased dinoflagellate blooms and other sorts of impacts that weren't predicted by Santa Rosa.

Finally when we looked at some of the plans about the riparian restoration along Americano Creek, we did agree with the city's consultants that riparian restoration is valuable and important to the resources, not only for the fisheries, but also in increasing flows to the Estero. In fact, one of the consultants' reports indicated that the restoration of the riparian zone could increase fresh water flow alone to about 2 or 3 cfs without any other discharges - just from the fact that with the riparian vegetation there would be less compaction of the soils. There'll be more storage of water in the riparian zone. That measure alone might supply some fresh water that could be sufficient for the restoration of the estuary.

So it was our conclusion that indeed the estuary could benefit from some fresh water flow enhancement. Some of that might be achieved through the restoration of the riparian corridor. Certainly the wetlands deserve protection, much more than they have now. That could be done through reduction of grazing and other sorts of practices. What's needed for the Estero is a more comprehensive research program - one that's not directed necessarily to a discharge release amount but rather toward the enhancement and understanding of the Estero.

When we released our report, it brought about a great deal of interest from the city of Santa Rosa, its consultants, and the community. I know that Santa Rosa has been active in trying to respond to some of the questions we have raised. In fact, just this Thursday I received some of their responses to some of the questions we raised about wetlands. We asked about copper loading in the estuary, and I've seen that there is substantial improvement in some of their reports.

Another important response, as well, has been a proposed lowering of the amount of discharge in the summertime. The city's consultants are now recommending that that discharge be lowered to 2 cfs per month during the months of spring and summer. We feel that that is a good change, because 7 cfs, we felt, was really deleterious to some of the wetlands and resources in the upper portion of the estuary. We think that's an important change. However, there would be more discharge during the winter months, and neither Tim Hollibaugh nor I have had a chance to look at that impact.

Another important thing which came out of some of the recommendations by the city's consultants is for the establishment of an Estero Institute, which would be comprised of agencies and independent scientists who would look at a program that could be developed for the Estero and who would come up with some strong recommendations on a scientific basis. I think that's a good recommendation.

One problem, however, is that even with 2 cfs recommendation, by the year 2005, I believe the city will need another place to put water. They will need beyond what the allowable discharge would be. The Estero Institute, supposedly, would make a recommendation. But then we're beginning to move out of the realm of science and into the realm of politics and decisions that are made by agencies. Having participated in this program and having seen what's going on, I think our strongest recommendation would be to establish an independent review panel now, as opposed to waiting for the project to get started and see what happens - and to establish the Estero Institute (or whatever it might be called), and really look at a complete and comprehensive research program. You'll see from Randy Chambers' presentation what a research program for Tomales Bay is like now and what it could be for the Estero in the future. We'll answer questions after Randy's presentation.

Appendix 2

Scientific Research On and Near Tomales Bay

Randy Chambers

Tiburon Center for Environmental Studies

I want to explain a little bit about the scientific research that is ongoing in Tomales Bay, some of which has been completed over the past couple of years. This will be sort of a progress report for Tomales Bay to bring you up to date on some of that information. First, let me just say that there is some research at Tomales Bay that I am not affiliated with. I've just started with the Land Margin Ecosystem Research Project funded by NSF.

There are other research projects ongoing in the Bay. One of them is being performed by sedimentary geologists at San Francisco State University who are measuring the sediment transport patterns in Tomales Bay. Dr Karen Brose has deployed a number of drift-markers out on the Bay. They either move in the water column itself or down on the bottom of the Bay. They're trying to simulate where sediments may be found and where they may be moving in the Bay. Dr. Brose has released a total of 400 drift-markers in the Bay and they travel through the Bay in currents, in the water column, and down near the sediment surface. Local folks have been collecting these drift-markers. There are instructions written on plastic tags as to where you should send them. A couple of people have mentioned that they're concerned with sedimentation patterns, with different sections of the Bay filling in at faster rates than others, and information from Karen's study will, I think, contribute to our knowledge of these processes.

There's a biologist from the University of Maryland, Dr. Bill Dennison, who last year was completing his study of the effects of increased nitrogen and phosphorus applications on the growth of sea grasses around Hog Island. And from some of the presentations we've heard earlier, there's a potential for increased sea-grass population around the Bay. In considering the effects of increasing fertilizer run-off (particularly in the rainy season) or overflows from septic systems, then what happens to nitrogen and phosphorous in the natural system is an important consideration. Bill's work on that topic provides us with crucial information in this area.

There are other examples of this type of work which is being performed in Tomales Bay. Someone has just initiated research on the distribution and abundances of the different species of sharks in Tomales Bay. This is information material not only to the health and welfare of Tomales Bay, but also to the health and welfare of those diving in the Bay.

The major scientific effort in Tomales Bay is one spearheaded by Tim Hollibaugh of San Francisco State University and Steve Smith of the University of Hawaii. It's a 5-year study of the bio-geochemistry of Tomales Bay, which has been funded by the National Science Foundation. What I want to do is describe the project for you briefly, how it operates and what we have to learn from this particular study. We're in the first year of this 5-year project.

The primary objective is to understand how Tomales Bay functions as a connection between the land, on the one hand, and the open coastal waters on the other. This may be, perhaps, a little simplistic, but Tomales Bay is like the middle-man between processes occurring on land and those occurring in the open ocean. And it exhibits characteristics of both land and the open ocean.

The first year of our study has been one of detailing some of the various physical, chemical, hydrological, and biological aspects of Tomales Bay. Every two months a group of scientists from San Francisco State University, University of California at Davis, the University of Hawaii, and the University of North Carolina converge on Tomales Bay to conduct this work. For about 10 days we stay at the Marconi Conference Center and process the water and sediment samples that we collect from the Bay during this particular period. The Conference Center has kindly provided space on the premises for this work and we thank them for that.

Some of the things we measure are water salinity, bacterial counts, chlorophyll concentration, water clarity, temperature, dissolved oxygen concentrations, concentrations of dissolved nutrients such as nitrogen and phosphorous, and sediment load in the water. We're measuring these indicators of water quality at two kilometer intervals along the length of the Bay. So, we have these water and sediment collections at ten different stations along the length of the Bay. We're also collecting water from Lagunitas Creek for a similar water quality analysis. And on the bottom of the Bay we have installed a number of different chambers to measure the exchange of nutrients between the sediments on the bottom and the overlying water column. We also collect cores of mud to determine the physical, chemical, and biological nature of that material, because it, too, changes over the course of the season in Tomales Bay. It turns out to be quite different from one section of the Bay to another. So, we put all this information together into a sort of mathematical model.

We've just completed the first year. And this first year has been pretty dry, as have the last 3 years before that. We're looking forward to seeing what happens during a wet year in Tomales Bay. What we've found is that during dry years, the Tomales Bay estuary produces a lot of organic material. This organic material contains not only primary production organisms like algae, but microscopic phytoplankton and macroscopic algae seaweeds and so forth. There's production in sea grasses and in marsh grass. And of all this organic matter that is produced, most is consumed in the estuary itself and is not transported out into the adjacent coastal ocean. In fact, there is an excess of organic matter that is actually imported from somewhere into the Bay. Thus the sources of excess organic matter into Tomales Bay are either from runoff from the land or from oceanic transport in by the tide. One thing that we haven't really figured out yet is where this excess organic matter is coming from. The system is considered net heterotrophic, that is, consuming more organic matter every year than it is producing. So that's an interesting conclusion we've reached.

We've also found that as to the major nutrients, nitrogen and phosphorous, more phosphorous remains in Tomales Bay relative to the amounts of nitrogen. This suggests

that nitrogen may be a limiting nutrient--during dry years anyway--on Tomales Bay. We don't, again, have information for a wet year. If and when we get a wet winter in the next 4 years, we'll be able to compare how Tomales Bay functions during dry seasons with little runoff and during wet season with substantial runoff.

Eventually we also want to see how different parts of the Bay contribute to this big-scale, broad-brush approach that we're taking. What is the contribution of individual components of this system? How important are sea grasses and seaweeds to production? How important are muds and marshes to the overall exchange of materials that we're seeing? How do animals, such as marine animals, fishes, birds, and aquatic mammals, contribute to and influence that picture? And finally, can human populations alter things so much as to, in a figurative sense anyway, completely change the focus of that picture? And that's something that I think we're all concerned with.

This information that we obtain is crucial not only for Tomales Bay--which is pretty much a pristine site--but also for other estuaries around the world which would benefit from the knowledge we garner here over the next 5 years. So, I think a couple of recurring statements that have come out in today's presentations are: (1) We're poised right now to collect information over wet seasons, and we're waiting for wet seasons so that we can do that. I think there are a number of different studies which are interested in looking at environmental change under different conditions (under wet and dry conditions, specifically); and (2) We're instituting in our study a long-term project of data collection which will give us an important data set which will allow us to draw some important conclusions regarding the function of Tomales Bay.

QUESTIONS:

Q: Could you explain briefly what you meant by the nitrogen limiting factor relative to phosphorous?

A: If you measure the concentrations of nitrogen and phosphorous in the water column itself, there is an excess of phosphorous relative to the amount of nitrogen in the water. It suggests that there must be a sink for nitrogen in the system and that nitrogen is being utilized through some fashion. We propose that not only is nitrogen being utilized in primary production as an important nutrient for the growth of plants, it's also an important terminal electron receptor for denitrification reactions that Dr. Bennett was speaking about previously. There are two different sinks for nitrogen in that particular system and it may be that carbon is ultimately controlling the nitrogen limitation.

Q: Where are you sampling in Lagunitas Creek - above the tidewater?

A: The water is collected above tidewater up above the Highway One Bridge.

Q: If there's any failure of the septic system in Pt. Reyes Station, will your study be able to detect that?

A: It would probably detect that. We not only sample every two months for ten days, but we also sample during significant rainfall events in between the regular sampling time. So, it's possible and likely that we would detect that.

Q: You mentioned you were doing some bacteriological tests. What tests were you performing?

A: They're simple bacterial counts. No one is doing any work on the actual identification of them in terms of *E. coli* versus other bacterial types. It's simply a counting technique.

Q: Does the person in charge of the study want to get those little yellow test umbrellas back from the Bay or would you rather that people left them?

A: Just call in or send back the information about the location on them if found. There's no need to send them back. There are instructions on them. Don't let them go again.

Q: (from Dr. Joel Hedgpeth) How many tide gauges are you running in the study? We had three, 25 years ago. It's a very tricky tidal pattern.

A: We have just one. Dr. Tom Powell from U.C. Davis is the person responsible for the two large yellow buoys which are currently out on the Bay. And he is collecting the circulation information out there. It's certainly true that the circulation patterns on that Bay, which are quite different from any other estuary around, will be important to the overall exchange of both water and nutrients in the system.

Q: Are you running rain gauges and, if so, where?

A: There are some rain gauges out and they are located at various places around the watershed, but I don't know where specifically. My familiarity with the project is only recent, so I don't know everything.

Appendix 4

Panel Discussion

The Honorable Robert H. Kroninger, Guest Moderator

Bob Kroninger: A friend in Inverness, who is more erudite than I and subscribes to *Science* magazine, called me a while back and he said, "You've just been quoted in *Science* magazine." And I said, "What for?" "Well," he said, "you apparently wrote a decision in which you held that water doesn't run uphill." I didn't recall it at the time, but he brought a copy of the magazine to me and I think it might be appropriate (I hope no one will be offended) if I read the lead paragraph of that article. It reminded me of a case actually arising in Marin County, although I was a judge in Alameda County:

"Nearly two decades ago, Judge R. H. Kroninger, in ruling on the effects of logging in a California watershed, noted that numerous expert witnesses in geology and engineering presented conclusions that were "hopelessly irreconcilable" on such critical questions as how much and how far solid particles would be moved by any given flow of surface water. The witnesses were able to agree only that sediment will not be transported upstream.

To students of rivers, the words sting, even today, for however hyperbolized the ruling may have been, it reminds of a painful truth. We still do not understand complex, non-linear, fluvial systems with their internal thresholds and their evolutions that span geologic time."

Now that, I think, leads well in to the first question which is:

Bob Kroninger: If siltation of the Bay stopped today, would any natural flushing action of tide and streams accomplish any restoration?

Steve Chatham: I think probably I'm not the one to answer that question. But I will say that the Bay has a relatively low tidal exchange. And I think the answer probably comes from somebody like Philip who has a better understanding of estuary hydrodynamics.

Philip Williams: It would shift the balance between sea level rise - which is now about 0.7 ft per century - and sedimentation back to where sea level would dominate over sedimentation.

Bob Kroninger: For Dr. Bennett: With the free-ranging cattle, how is manure managed?

Rick Bennett: Pretty freely. But we can probably improve the distribution of the manure on the range in the watershed by a more appropriate application of cross-fencing. My colleague, Stephanie Larson, has travelled to New Zealand and studied how they do

that. They're totally dependent upon the natural range for sheep and dairy production. And they are probably the world's masters at range management. And through systems of fencing and moving cattle regularly, such as daily, they get manure distributed much more widely than we do when we allow animals to congregate around feed bunks and water troughs and then meander off to graze. If manure distribution was the goal, fencing could solve that.

I think we have to acknowledge, though, that the distribution of manure in a free range situation is generally inadequate. And you can witness the little tufts of green grass growing on the hillside, which suggests that the nitrogen is limiting greater grass production that happens if more management could be applied to free-range grazing.

Bob Kroninger: Is there any planting program to reestablish bunch grass?

Steve Chatham: There are a number of small planting programs around to reestablish bunch grass. In fact, I just ran across one a couple of weeks ago. When I went out to visit John Kelly and Skip Schwartz at Cypress Grove, there was a greenhouse full of native California bunch grasses, which are being planted on the property over there. I am not aware of any broader scale applications of bunch grass planting in the Tomales Bay watershed. Converting from the annual grassland to the bunch grass is a time-consuming process. And when you're in the agricultural business, it becomes a very expensive proposition, because to do it effectively the lands have to be taken out of production for approximately two years.

Bob Kroninger: As you might expect, we've had a number of questions directed to the Santa Rosa proposal to dump its treated effluent here in the Estero. To summarize them, the question is: What should we expect if the Santa Rosa program is permitted to proceed with its proposal to dump its effluent into our Estero Americano? What changes might there be?

Answer (James Clegg, Bodega Marine Laboratory): Right now the Marine Lab feels that the lower Estero and the eel grass is in pretty good shape. And we really wouldn't want to see any long term degradation. We'd like to see an enhancement project move forward to insure that the Estero will stay in its present condition.

Bob Kroninger: We've got a number of questions on the effects of the degradation on the various creatures that we have. One is crabs; what about crabs? Are they subject to the same kinds of problems as the bivalves and fish that live about the Bay?

Tom Moore: Well, crabs can either spend the early part of their lives in the estuary or in the ocean. It just depends on how many are out there, and how many end up in the Bay. It's more of a pass and transport into the Bay than dependence on conditions in the Bay that affect their life. If they never come in the Bay, they're not going to be affected.

Bob Kroninger: What about the red tide? Does that affect crabs?

Answer: The visible red tide is caused by one species of dinoflagellate. This is not the species associated with shellfish poisoning which I think you were beginning to mention. Paralytic shellfish poisoning is caused by another dinoflagellate which, when it occurs in large numbers, makes the shellfish toxic because they feed on it. This is not often associated with the visible red tide. It's usually not visible and that's why we have to sample the shellfish and test them for it. I don't believe it has any effect on crabs.

Bob Kroninger: There have been several questions on this topic: What is the status of clamming, and what can you project for the future?

Tom Moore: I've been doing some work looking at the clam harvest. On an annual basis, there are about 11,000 clam diggers who come out. Presently, there are enough clams to satisfy most people. Ten to 15 years ago the clams were larger. It's hard to tell what the population is now. I think we have enough clams to sustain the present harvest, but the populations are somehow being impacted.

Question from audience: Somewhat related to that, somewhere around 1984 or '85, I witnessed an enormous number of sea hares on the beach right at Marshall Boatworks, which had apparently come out of the water and died. My guess is that there were over a hundred and I've never seen sea hares like that. I'm not aware of how common they are. But what was there about that year that might have caused a mass extermination of sea hares in a short period of time?

Michael Ellis: There was an explosion of sea hares off of Half Moon Bay at the same time, but I don't know why.

Answer: It may have been related to El Nino. In Tomales we saw effects on the herring in 1984. What we saw was a push towards the north of less common organisms. That's about the only thing I can think of that might have such an impact.

Bob Kroninger: Here's a question for Phil Williams. You may feel that you've already addressed this as far as you can. If the Giacomini pasture lands were restored to being a salt marsh nursery, what would be the effect on the biological health of Tomales Bay?

Philip Williams: I don't think it matters right now. What we need to know is the relative part the salt marshes play in the ecosystem of Tomales Bay. I think some of the research going on right now will give us some sense of how important they are. In any marsh restoration, you have to be very careful about what your goals are - what you're really trying to achieve with the restoration. And at this stage, I can't see the definition of what that's all about.

Randy Chambers: I'd like to comment on that. Our science project does include a salt marsh study. And we have some further proposals for looking at the exchange of nutrients between salt marshes and Tomales Bay. So there are proposals, at any rate, to do that work.

Bob Kroninger: I have several questions on the metals being found here. One is: What is the source of the copper?

Steve Chatham: I don't have a definitive answer on this. But once again, what came out of the City of Santa Rosa probe on the Estero Americano was that the copper sulfate bath that the dairy ranchers use to control a disease in cows' hooves may be a contributor here. Someone mentioned old plumbing. Actually, new plumbing, too, has an effect, but it's not as significant.

Rick Bennett: The disease that Steve is referring to is called footrot. It's caused by a bacteria that gets in between the toes of the cow. It's caused by the feet being in wet conditions. The dairy farmers need to have the foot bath to control that. When used, it is supposed to be in concentrations of something around 5 to 10 parts per million of copper or copper sulfate. What we find on the dairy farm is that they don't know what 5 to 10 parts per million is. So, it's just a coffee can full of copper sulfate in the foot bath. And they're probably using several orders of magnitude more powerful than they need to control the disease. Lameness in dairy cattle is very common and it seems to have become more common lately. There's some new evidence to suggest that it's not footrot, but that it's a nutritional problem associated with the high-grain diet. It's like what is found in horses. We may be able to remediate a lot of copper use on the dairy farms, just by more appropriate solutions for the problems.

Bob Kroninger: What is being done, if anything, to stem the flow of mercury from the abandoned mine? And if nothing's being done, what can and should be done?

Answer: The mercury mine is an interesting situation for me. The Marin Resource Conservation District had a study done by a firm out of Sacramento regarding the actual toxicity levels in the mercury mine. They did both water sampling and sediment sampling. The water that came out of the mine was so clean that the laboratory thought that the technicians had goofed it up. So they ran all the tests a second time and came up with the same answer.

On the other hand, the sediments that were found in the mine area were found to be in excess of California's Department of Health Services standards for mercury content. There are two places where mercury can come from in the mine. One is from the spoils from the process. And the second would be from the background material that is in the area, i.e. mercury might happen to be there. In practicality, what it really means is that by controlling the sediments that come out of the area, you can control the mercury. There is a need to do more work on sections of the mine which have predominantly been loosened up in the process of pushing around the soil in search of mercury. We're looking for

funding. We're looking for solutions. Our primary problem is one of funding, and it is a big problem.

Bob Kroninger: Next question: How can an individual or organization get prior notice of an application for or negotiations for a mariculture lease?

Tom Moore: You can get in contact with a Sacramento branch of California Dept. of Fish and Game. They have an aquatic development section for fresh water and marine aquaculture. And right at this point in Tomales Bay, there are no available leases for what is out there right now. People are waiting for leases to become available through others relinquishing. I don't know what the advertising or communication route on this is. There are no plans to create any more leases.

Bob Kroninger: Given the limited availability of funds, what is the most urgent, single thing to preserve Tomales Bay from further siltation?

Randy Chambers: In our particular research area, we're looking at a lot of characteristics of the sediments themselves in terms of associated nutrients. Any approach that would decrease the nitrogen and phosphorous on the sediments would be a key to management of Tomales Bay.

Philip Williams: Well, I'll just kind of reiterate what I said before. It's interesting that in Bolinas Lagoon you have a similar problem. And the people who are concerned about Bolinas Lagoon, of course, have limited funds. And they identified that the most valuable use of those funds, was to simply be able to document right now how much siltation has occurred. And they've spent what little amount of money they have on surveys to establish what the long term trends are in order to be able to build a political case, I guess, for taking some action toward a remedy. I think in this case, for Tomales Bay, simply getting pressure on NOAA to do a full-blown hydrographic survey of the Bay as they've done in the past would be extremely valuable.

Answer: Siltation by itself really is not a great concern for public health and shellfish. The only connection might be its connection to input of manures perhaps from the grazing of livestock right in the stream courses. Some of the things that might be done to cut down on siltation would also reduce the input of manures.

Rick Bennett: Since the land we're talking about is by and large private land, and since we've dumped a lot today on the dairy producers and the livestock producers, I think we need to find a way of making erosion protection pay. And that may mean that one of the things you can do is to buy carefully and know who you're buying from. That's very difficult if you go to the major supermarkets, but we've got to be able to show that the practice of soil conservation can reward the producers them in the short term as well as the long term. Although they're going to be very skeptical of anything we say, the marketplace might speak to them and get them to pay attention.

Steve Chatham: To the extent that we're sure that siltation is the evil problem that it's made out to be, I think that in the long term perspective the most significant thing we can do is find ways to make the erosion control pay for the ranchers, as Rick said. That's a fairly difficult problem. I would particularly like to see progress being made in the area of range management, and in finding ways to distribute livestock over the land in more beneficial ways, ways in which productivity can be maintained or even enhanced. At the same time, we can get more cover on the land, more indigenous growing matter and a greater quantity of grasses.

Also, I want to take a moment here to talk a little more about the ranchers themselves. Somebody approached me during the day and commented that I didn't say very much about the efforts the ranchers are making. And I don't want the people here today to think that the ranchers are not concerned about these issues, because they are very concerned about them. The ranchers are doing what they can, within their capabilities, to try and correct these situations. Many of the ranchers participate in the Agricultural Conservation Stabilization program in which they match funding with the federal government to do such things as cross-fencing in watering areas, which does help with the distribution of fertilizer. Many ranchers do seed and fertilize every year. And many ranchers are very willing to talk to us about how these things might be developed even further. Range management is really the place where I think some beneficial effects will come about.

Appendix 6

Transcribed Questions From the Audience

For:

Tom Moore	Q.1
Lisa Jang	Q.3
Douglas Price	Q.4
Michael Martin	Q.6
Steve Chatham	Q.7
Rick Bennett	Q.9

Tomales Bay Herring Fishery in Decline?
Tom Moore, California Dept. of Fish and Game

QUESTIONS

Q: What's the prognosis? Are we going to have good herring fishing in the future or what can we expect?

A: I wish I knew. If we have rain this year, we should see some return of fish to the Bay. There will be loss of genetic material with the movement of fish out of the Bay. The loss of that portion of the biomass won't come back and it may affect us.

Q: Do you have any information as to what effect, if any, the damming up of Lagunitas Creek and the removal of that water has on the herring fishery?

A: From what I've seen and the way the fish are spawning on the bottom of the Bay, I think they really need to have some fresh water input. The fresh water biologist of the area, Bill Cox, said he'd figured it might take about 2 years of normal rain before there is any significant spillage from the reservoirs.

Q: (Michael Ellis): In '78, the year of spawning spike in Tomales Bay, did the guy who was doing parasite studies do such a study that year?

A: No, the study started in 1980.

Q: (Michael Ellis): When you talk about stocks, are you talking about the same species of herring? You mentioned green herring.

A: Yes, I used a little jargon there. What I meant when I said green herring was immature herring. I talk to fishermen a lot and use a lot of their terminology. So these are herring that aren't ripe yet. The eggs aren't ripe and the herring aren't ready to spawn.

Q: So the range of herring that you showed on the map, that's the same species of herring in different stocks within the range?

A: Yes. The herring on this coast are considered a separate species from the herring on the East Coast. The species here is coast wide.

Q: If you have a law suit, would you close down the herring fishery?

A: We would acknowledge that option. I don't want the fishermen chasing the herring around the Bay. We've got the entrance to the Bay protected. This allows the fish free entry. That's why we have that line there (outside the mouth of the Bay) to give the fish free movement into the Bay without increasing activity of boats or nets in that area. So if they want to come in there is nothing stopping them - no noise, no propellers, nothing.

Q: How big of a disturbance to the fish are the recreation boats in the Bay?

A: A lot of the fishery takes place at night. The daytime disturbance doesn't amount to much. But if there were a lot of noisy recreational boats, it could actually run a school out of the Bay.

Q: After they harvest the roe from the fish, what do they do with the rest of the fish?

A: The fish are taken to Korea.. They're frozen over there. They're allowed to thaw for 4 days and ripen. Then they remove the roe from the fish. And those carcasses, after having 4 days to properly "ripen," are used for some sort of food and fertilizer. There's some special name for the food. I don't know what it is, offhand.

Tomales Bay Oyster Industry
Lisa Jang, Bay Bottom Beds Oyster Co.

QUESTIONS

Q: Could you tell us more about the new leases?

A: They were awarded March of this year. They are still kind of in legal limbo because of the limit of funds. As far as I know, nobody has actually signed a lease yet. (Comment from audience: Actually there are 2 of them signed now). Okay, that's new. I'm not sure who signed them. Most of the leases were awarded to companies already here on the Bay. The leases are from California Dept. of Fish and Game.

Q: With regard to your clean-up program, I was astonished at the amount of plastic debris from the oyster industry. What do you think about that? Is there something you plan to do, or are you aware of this?

A: That has been addressed. The pipes out there are a problem.

Comment: (Terry of Hog Island Oyster Company): There's a lot of oyster growing on the Bay and there's an awful lot of debris out there. The overall clean up problem does need to be addressed more thoroughly.

Q: (Michael Ellis): Are we talking about the same kind of debris? The reference is to plastic lids and plastic coffee can things that are used to separate the spat. Is that what you're talking about Lisa?

A: I was talking about some pipes that were left by an oyster operation. What you're talking about sounds like things that are used by Johnson's Oyster Company. His operation is on Drakes Bay. He does have his shore-based activities in Inverness and perhaps some of this stuff comes over on the the Tomales Bay side. He's actually not in the Tomales Bay Shellfish Growers Association. He's been invited to join, but he has not.

Comment (Skip Schwartz of Audubon Canyon Ranch): I don't know if people are aware, but there is a monitoring program that Fish and Game and Audubon Canyon Ranch are involved in to assess the relationships between aquaculture, sedimentation, shorebird and waterbird populations. So that's a really interesting study that will go on for a number of years. We'll all learn more about it later. It's coordinated by Audubon Canyon Ranch and the Dept. of Fish and Game in cooperation with the growers.

Q: How does the sedimentation on the Bay affect the growers in the southern part of the Bay?

A: It depends on how you grow your oysters. We grow our oysters in plastic mesh bags that are held up off the mud. So sedimentation doesn't really affect them. Nobody seems to grow oysters in the Bay the same way. So it would depend on the method the various oyster companies use.

Tomales Bay Oyster Industry
Dr. Douglas Price, Calif. Dept. Health Services

QUESTIONS

Q: Are you aware of the septic system being used at Stinson Beach which has required inspection and installation standards? And, if so, do you believe something like that would help around Tomales Bay? These are individuals on residential systems. The district has the right to go on the properties and determine whether the septic tanks and the leaching lines are working. And if they're not, they will require fixing.

A: I think that's an excellent idea for the Tomales area.

Q: At the end of June, the department made a survey of various areas on the west side of the Bay. What was done? I've seen no results. Are there any results to report?

A: There is a report in the works to summarize that survey. We only looked at points that were right adjacent to the Bay. We did that during the dry season. It wasn't really the best time of the year to look at inflows into the Bay. But we did identify a number of streams and inflows to go back and reexamine during the wet season. We were looking for a number of things. One was the gross inputs of sewage from individual business along the Bay. We did not see anything of that nature where septic system bypasses and sewage were going directly into the Bay. There may be some failure of systems in the winter time. This needs checking. But that survey report will be out soon.

Q: Has your department taken a position on the effects of pollution from the proposed Santa Rosa Estero Americano project on shellfish, such as mussels, oysters, and so forth?

A: As a program, we have none. There's the shellfish sanitation program. I almost hesitate to express an opinion on the matter, because, I'm not very well versed in the issue. I think that we don't see it as a problem in terms of microbiological pollution since the effluent is highly treated with disinfectant. The question as to whether it could possibly create elevations in chemicals, such as heavy metals, in Tomales Bay sufficient to affect the shellfish is something that I can't answer. It's possible, but I have a feeling that there's not that much industrial input into that sewage from Santa Rosa. We would certainly be watching it. And we would be using information from the mussel watch program, which Dr. Martin will be speaking to us about.

Q: The second half of the same question is, before the decision is made were you asked for a recommendation regarding this subject?

A: Yes. I'm sure we should have been and probably were. But we haven't gotten down to the shellfish sanitation program with the question.

Q: Am I correct in thinking that the E. coli is used as an indicator of the possible presence of human pathogens?

A: Yes. There are other pathogens that affect humans, that can arise from cattle, dogs, birds, or other warm-blooded animals. When you speak of the viruses, you're correct. Viruses tend to be much more specific to the host. You might get human hepatitis in the count, but you could get other bacteria such as Salmonella.

Q: What is the technology for recognizing pathogens in addition to E.coli or the specific E. coli?

A: The particular technology is not really there. We do need this technology, because we'd like to know whether the fecal coliforms are coming from birds, or from housing and people. But we don't have that capability. It's being worked on. And the rules under which we operate, our regulations, don't make that distinction between sources. Fecal coliforms are fecal coliforms and that's it. Once you get the ability to pinpoint the source, then maybe you could have different levels depending on the source. We're really not there yet.

Q: Whose responsibility is it to see that septic systems operate properly?

A: It's the County - Marin County Environmental Health is responsible for individual waste systems.

Comment. (Michael Ellis): Obviously the person who owns the septic system should take the responsibility.

California Mussel Watch
Dr. Michael Martin, Calif. Dept. of Fish and Game

QUESTIONS

Q: To what extent are copper and chromium necessary to marine organisms?

A: Many trace elements, and probably none of the synthetic hydrocarbons, are essential to the normal growth and development of organisms. And if you have conditions in which you don't have enough of these chemicals, it's toxic to the animal, or causes a toxic response. But if you have too much, it's a problem also. Copper is clearly that way for the shrimp species. The crustaceans, in general, require copper. And they also have quite an enzyme-regulating system which regulates the copper. So if you concentrate copper it can cause toxic effects to the animal.

Q: I was wondering where the sample location is?

A: The sample location for the state program is near the Spengler residence on Tomales Bay.

Q: What is the frequency of the state sampling?

A: The answer is that our locations are generally sampled once a year, except when we have a special study such as national pollutant elimination program where we sample quarterly.

Q: Are there heavy concentrations of any contaminants in the Bay?

A: This Bay seems to be relatively pristine. And I can't truthfully say that my highest priority would be to continue an intense monitoring. I think the idea that was mentioned of an infrequent sort of "let's check and see what's going on" is important. And I think, secondly, there may be a variety of contaminants present which we really haven't identified and which may be of some concern.

Q: Are you using the shells? Have you made any determinations of mussel shell? We've done some determinations on sea urchins and we've found a fairly high cadmium count in sea urchin shells.

A: For certain contaminants, the shell may have some advantage. Any contaminant that interacts with the deposition process in the shell may be enhanced in the shell. Ed Gulmer did an evaluation on the regional national mussel program in 1975 to look at the radionuclide series. Lead, cadmium, and zinc, I believe, were the elements. And shells might be very useful for lead. As for the other trace elements, we're not too sure about them. I don't think anybody has looked at shell deposition with any of the hydrocarbons.

Watershed Restoration
Steve Chatham, Prunuske/Chatham

QUESTIONS

Q: How much does one of those projects cost? And does the rancher have to pay for any or all of it?

A: One of those projects costs tens of thousands of dollars. We rarely see a project that costs less than \$5,000. And with this project, to date, we've spent \$100,000. The ranchers have not had to spend any money on any of the projects, to date. The funding has been supplied. And it points to an interesting situation that's developed. When we first came here to the watershed and started our work, we got nobody to participate with us. It took us three years to get on anybody's ranch. It's totally voluntary on the part of the ranchers. And I am sure that there have been some concerns about who these people are coming in from the outside: "They don't know what they're doing. All they're going to do is come on the ranch, make a big mess, and cause a lot of trouble for me." I think it's been very important that the Marin County Resource Conservation District, which is a rancher-controlled organization, has been sponsoring the project. Otherwise, I don't think we would have gotten anywhere. But the ranchers aren't always motivated to put money into it.

Q: What's the likelihood of continued funding in the light of federal budget cuts?

A: Well, I've never gotten any money from the federal government. Our sources are the State Coastal Conservancy, the Buck Trust, and the California Dept. of Fish and Game. These are the main sources of funding. We're trying to get some water quality money to work on the monitoring.

Q: Do you have any projects going on that are preventative by nature?

A: Most of the projects I've presented are basic repair work and we don't have any projects that are preventative in nature. The kind of projects that are preventative in nature involve range management.

Q: Are you using native grasses for restoration?

A: Native grasses are always on the list of candidate species to use whenever there's a restoration project. Although we don't limit ourselves to native grasses.

Q: That toe slope where you had the filter fabric and willows, or whatever, and then the stone over it - were those stones set by hand or mechanically put in?

A: On the toe where we put the willows and the rock over the filter fabric as you saw in the picture, the stone was placed by back hoe, one rock at a time. The rock was too big to place by hand.

Q: Could you talk a little about the need for negotiating easements on the range lands?

A: One of the things that always helps when you're in this type of negotiation is money in return for giving something up. I think the Agricultural Land Trust has gone a very significant distance in preserving open space and agriculture, and in preventing development by acquiring agricultural easements. Similar mechanisms could be used for acquiring conservation easements or riparian corridors, where the owner would eventually give up his or her right to use the riparian corridor in exchange for some dollar value. Or, for example, conservation easements could be used on the range land to perhaps buy a right to the last 2,000 lbs per acre cover on the range land and thereby preserve and enhance range lands.

Q: Is a certain amount of erosion inevitable in this type of agricultural practice? How does it compare to erosions in forest harvesting?

A: A certain amount of erosion is inevitable in any situation. Erosion is a natural process. And, by all means, we do not want to stop all erosion. With regard to the other part of your question, i.e. how does erosion in an agricultural area compare to erosion in a forest situation - both of them are perfectly capable of generating a huge amount of sediment. The advantage to the timber industry or the timber situation is that the disturbance comes once only every 10 or 20 years or something of that sort. The advantage to the agricultural situation is that when the disturbance occurs it's not necessarily as severe.

Q: Who supports these programs?

A: The taxpayer. That's a sort of vague answer. But what it boils down to is that it's got to be the taxpayer or private foundations. Certainly, foundations can contribute within the context of their goals and objectives.

**Preventing Animal Waste from Degrading Water Quality
Dr. Rick Bennett, UC Cooperative Extension**

QUESTIONS

Q: I'd like to ask what weed control methods are appropriate?

A: It's highly situational. In some situations, chemical weed control seems to be appropriate because of the tremendous extensive invasion of some of the species. In other situations, going in and mowing the weeds down, overseeding them with some more vigorous types of grasses, fertilizing and getting the grasses up before the weeds is appropriate. So it really is a mixed bag.

Q: In that slide you showed of the big slope where you said it would not be appropriate to spread the manure, does that apply to a less steep slope?

A: Yes any slope, where you have no vegetative cover and you put a fairly heavy application on of 5 or 10 tons of manure per acre, the potential for overrun in a heavy rain in early fall is very good. But the residual dry matter is also a very important concept to sustainable range management.

Q: What's the maximum slope that you recommend for application?

A: You're generally limited by tractor access. There are people who fly on nutrients when you can't drive a tractor. But we've had a farmer killed in this region because he tried to fertilize on ground that was too steep. So safety is the limiting thing.

Q: Is there any data on the effect of methane digestion in the waste program?

A: Well I've had a lot of experience with the project in Marin County. It will reduce the balls of solids a little bit. But that's about it. The chemical oxygen demand, the biological oxygen demand, the nitrogen, the phosphorous, and the potassium are still there. What it does do, though, is give a little more value to manure. Let me say this: I think because this is a major problem throughout the world, that consumers are going to have to start investing in different kinds of farming practices. And I think most people would be willing to pay a cent more per gallon for milk if they knew that cent a gallon was incurred by getting back into farm practices to mitigate these problems.

Q: What are the economic incentives for farmers to implement these range management practices for pollution control? Is there some definite payback or a dead loss?

A: Right now on a cash flow basis, it's going to be a dead loss. But there are some things happening in California that I think are going to shift some comparative economic advantage back to the North Coast from San Luis Obispo all the way up to Oregon. Water and land costs in the great Central Valley of California are going to start impacting dairy production in general. And it's going to make forage produced on the natural range or at a farm situation here much more valuable than it used to be. Alfalfa hay has been

very cheap in the State of California. It has a water subsidy by the federal government. And they can grow it very well and it has competed with land use in the valley. Alfalfa is going to drop out of the economic picture of the Central Valley in the next decade.

Appendix 5

Concluding Remarks

William J. Filante, M.D.
Assemblyman, 9th District

As I reflected during this conference, trying to go back as far as I could, the strongest memories I had were of being a member of the Citizens Advisory Committee for Tomales Bay studies, which was probably about 15 or 20 years ago. And, sadly to my way of thinking and that of others too, not enough has been said or done visibly since then. That was the biggest feeling I got from today's Conference. There's so much that we can do or advocate, but the biggest impact that we probably can have is to keep the consciousness level high for citizens in various walks of life, for government, and for private agencies like foundations. And with that high level of consciousness, to keep the questions coming. In other words, let us not become complacent by thinking that a cure has been obtained, that there isn't an urgent problem, or that there isn't an increasing problem. Speaking as a physician, we don't really know much, we don't really do much, we just practice. The answers aren't there yet. We just keep practicing till we get too tired and quit.

I think some of the major questions and problems have been addressed today - pollution, sedimentation or siltation, and the like. When I sat for four and a half years on the Marin Municipal Water District, many of these problems became very prominent in our deliberations, both during floods and during the tremendous drought. And you may remember, I was the president of the Water District during the worst year in the last drought. I was told it was all my fault, and I wasn't too sure at the time!

But in looking for projects in the County, that was when I first personally became aware of the tremendous effects of erosion and of our beloved industry of cattle and dairy in West Marin. What do we do about it? We didn't have any answers to the erosion, except that we didn't want to do anything in that part of the county or to the streams, streambeds, banks, etc. that might possibly worsen the situation. You've heard some of the suggestions today.

There were also pollution problems, due somewhat to the cattle industry and maybe homes. We've attacked and, I think, taken care of a few of those problems. The specter of major residential or commercial development in this area and for the watershed of Tomales Bay is pretty much gone. So that doesn't mean the cure, it just means we have a better fix on what the real problems can be. I think some of the New Zealand suggestions are good. I'll never forget how green everything looked when I was in New Zealand. But it's possible we could push further toward that goal if we had help.

What strikes me--and this is what we find in our legislative debates especially during crises--is that you have to look to a number of sources for funds. And I think that's what we were all hearing from our panel. Don't keep dumping on our farmers. Look to see if

the problem is being shared today. We have the State; the University of California; the County; we have the California State University system, including San Francisco State; we have the Romberg Center--all addressing some of our water problems. They should be involved. The Federal Government should be involved (I mean with dollars, not regulations). Our own agriculturists have to be involved because it's in their personal interest to stay in business and be environmentally sound. There are foundations. The Marin Foundation is located in Marin and has, as one of its original charges, the conservation of the environment, and it has responded to those charges.

The fact is that with help from various sources, you can achieve a lot. You can not only have cross-fencing, you can have planting. You can actually fence off areas closest to stream banks and water. You can have the daily rotation we heard about, rotating crops from one area to another area. All this can be enhanced by some of the changes we're working on right now, such as making more water available locally. Santa Rosa effluent is a problem. Properly treated, Santa Rosa effluent might be a help.

I think the bond measure on the ballot, Proposition 148, is a small but specific example of what could be accomplished. This proposition is the omnibus water bond issue, of which the major thrust is to reclaim and recycle water. Those of us from this area may recall that we produced the largest vote on any measure before the voters in any county in the history of California, that is a greater than 99 percent vote against the Peripheral Canal. Proposition 148, which largely concerns the reclamation of water in California, is a bond measure which represents the ability to produce a Peripheral Canal's worth of water by turning California's water policy away from damming, diverting, and damaging of bays and rivers. They're still talking about more dams and so forth--expensive water. At this moment, these solutions, as they are considered, remain frighteningly too expensive.

But part way there is recycled water which can produce for us usable, what we call swimmable, water. You can't drink it, although, you have to be able to ingest it occasionally if you're swimming in it. It's not drinking water. It's not potable. It can solve most of our water problems and it can certainly be used for irrigation. That's what we're talking about in reclaimed water projects. That should be plugged in here. And that means there are other state agencies that can be involved.

I think we need to focus not our particular narrow perspective of the bad guy or the good guy, but rather on the question itself. You heard this in the last few minutes. The most important thing you can do if you have limited funds is to gather information. We must do that. And we are the vehicle for that, the very individuals in this room, the very organizations that are sponsoring this conference, my organization at this moment, the California Legislature (until proven otherwise). And, if you will, even other associations I belong to such as the Medical Association, are concerned and must be called upon for help. Newspaper articles help - we get them every once in awhile. But your input, such as letters to me, letters to the editor, questions, meetings with the Farm Bureau and so on, is most important.

I could go on and on, but I'm going to stop. I hope that my message is clear and you will keep us involved. One of the things I have always said is use the power of the mail (only

a 25 cent stamp). Send a letter to your newspaper and send a copy to me as your legislator. (Incidentally, always send the original to the newspaper, because that's the only one they'll print). If I receive a copy of a letter sent to a newspaper, I'm going to read it. That letter might have been printed. Or if I receive a letter signed by "Your Former Supporter" asking how come I voted against the water reclamation project, I'm going to answer that one immediately.

Your efforts will make a difference. You will be heard. You were heard today. I'm delighted to be here.

Michael Ellis (Moderator): I just want to say, briefly, that we are part of the solution, not part of the problem. All of the people who participated in and attended this conference today are **doing** something. That's the least we can do. We're doing a good job, because we're all here. We're together. And I appreciate the interest and enthusiasm in Tomales Bay. Thank you all for coming.