

STATE OF TOMALES BAY CONFERENCE

Inverness Yacht Club  
Saturday, October 22, 1988

Tomales bay is recognized as one of the most pristine estuaries remaining in the United States. However, the bay and its watershed are increasingly subject to the pressures of residential and tourist growth, and the resulting expansion of commercial activity. How can we insure that this unique bay will be preserved? This conference will consider the Bay's varied resources and conclude with a panel discussion offering recommendations for developing a program of cooperative research and education to promote the health and productivity of Tomales Bay.

TRANSCRIPT EDITED  
by

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Due to the cooperation and enthusiasm of many people, the Tomales Bay Conference was a resounding success. The prospects for learning how to protect the bay seem brighter now. We thank the many helpers who gave unselfishly of their time:

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# FIRST ANNUAL STATE OF TOMALES BAY CONFERENCE

**Inverness Yacht Club  
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## **Introductory Remarks Corwin Mocine**

Professor of City Planning (retired), U.C. Berkeley

We are here to consider this beautiful estuary we can see outside our windows-- at least the ones that do not have curtains. It is the nature of estuaries to change, always changing. But many of us who live here around Tomales Bay or who regularly visit, are aware that this estuary is changing more rapidly in the last few years than it ever has before to our knowledge, and in ways that are not, as we see it, always for the best.

Therefore we believe that the time has come to take a really hard look at the Bay and what is happening to it by means of a major disciplinary study that will allow us to make findings that can then be translated into management of the Bay, so that we can make sure that when it changes, it doesn't change drastically nor in ways that are to the detriment of this wonderful and now even yet pristine body of water.

So this afternoon we will take a first look at some of the disciplines that we believe should be involved in such a study. While we don't pretend in a few hours this afternoon to do more than become acquainted with the nature of concerns that relate to the Bay, we do hope that this will be the first of a long series of such conferences which, over time, will produce serious, ongoing and interrelated studies resulting in a brighter and better future for the Bay.

Before I call on our first speaker, I would like to introduce Dr. Joel Hedgepeth, who was the head of the Marine Biology Center at the College of Pacific. He was almost the father of the study of this Bay and is known I'm sure to many of you. Dr. Hedgepeth, will you take a bow?

I should say before I call on our first speaker, this conference is sponsored by the Tomales Bay Foundation, the Environmental Action Committee and the Inverness Foundation. We also wish to thank Richard Plant and many others. Now in order not to take time from the real business of the afternoon, let me introduce our first speaker, Stephen Smith who is a professor at the Institute of Marine Biology at the University of Hawaii. He has been interested in this Bay for a number of years beginning in 1985, and, although his studies previously had related to coral reefs and the biology of coral and estuaries, he is looking for relationships between those tropical estuaries and our own. So without further ado, let me introduce Dr. Smith.

## PART I

### STATUS OF CURRENT RESEARCH ON TOMALES BAY Water Chemistry Exchange and Environmental Implications

Dr. Stephen Smith  
Hawaii Institute of Marine Biology

Following on the introductory remarks that were just made, I first heard about Tomales Bay, when reading some of the reports that came out of the Maxine Lab which Joel Hedgepeth ran here. So I certainly concur with the statement that any scientist studying this Bay is very much aware of the work done by Joel and his colleagues many years ago.

As Mr. Mocine mentioned, I have been involved in investigations here in Tomales Bay since 1985, with intensive investigation since mid 1987. The Bay is particularly useful "case history" for analysis of interactions between water composition and biological activity in the coastal marine environment. We have funding, primarily from the National Science Foundation, to continue this research for another year, and we are seeking funding to continue the research beyond that time.

Tomales Bay is ideally suited for such analysis because of its very simple shape, well-characterized stream flow, and slow water exchange with the coastal ocean. Low pollution in the Bay also makes it an ideal site for the study of biological-chemical interactions under relatively undisturbed conditions. Although the thrust of our investigation is so-called "pure science", much of our work bears on the "environmental health" of Tomales Bay.

Water quality data we are collecting include temperature, salinity, nitrogen, and phosphorus. These data are collected at 10 stations along the Bay and at stations on both Lagunitas and Walker Creeks with intensive sampling about every two months and some additional intermediate samples, as well as continuous water temperature records at four locations.

We require weather data for our analysis of water composition in the Bay, so we have established remote weather stations at either end of the Bay. Two such local stations are required, because differences in microclimate along the Bay and along the coast preclude accurate extrapolation from existing weather stations. We are cooperating with the National Weather Service in this venture. Our stations transmit data to National Weather Service radio receivers, and that organization provides the data to us.

We are also analyzing stream flow data from Lagunitas and Walker Creeks, furnished to us by the U.S. Geological Survey. Those data allow us to estimate runoff into the Bay. These gauging stations apparently represent about half the stream flow into Tomales Bay.

The following general patterns in water composition have been documented. Temperature at the mouth of the Bay varies by about 611 C, reflecting the seasonal temperature oscillation of the coastal ocean. With distance inward from the Bay mouth, there is a stronger annual temperature oscillation--from slightly below winter ocean temperatures of about 1011 C to over 2111 C near the Inverness Yacht Club. This large oscillation of water temperature within the Bay is a response to summer heating and winter cooling of that water as it remains for long periods of time in the Bay.

Salinity varies only slightly at the mouth of the Bay (usually near 33-34 o/oo, a typical range of values for coastal Northern California). At the head of the Bay, winter salinities can be

quite low (about half oceanic salinity during the low-runoff winter of 1987-88). During the summer, evaporation elevates salinity in the Bay about 1-3 ‰ above oceanic values. The seasonal oscillations of temperature and salinity within the Bay in response to weather and runoff provide an understanding about water exchange between the Bay and ocean. In the summer, water exchange time is largely controlled by tidal mixing and is about 4 months. Winter exchange is more rapid and variable because of stream flow which tends to flush the Bay. Exchange time was about 1 month during the dry 1987-88 winter.

Water exchange has a potentially important influence on the Bay. If a pollutant is introduced into the Bay, either by inward mixing at the mouth or by discharge from land along the shoreline of the Bay, that pollutant will remain in the Bay a long time before being washed out. Such a pollutant may be a particle which settles out rapidly, or a dissolved material which either reacts with the sediments or is taken up by organisms more rapidly than it washes out; the pollutant becomes trapped within the Bay. Such entrapment increases the potential for damage to organisms of the Bay and for eventual uptake into the human food chain.

Two important forms of plant nutrients, or fertilizers, are phosphorus and nitrogen. All life requires these nutrients, and they are often in short supply in marine and freshwater environments. Adding these nutrients to the marine environment tends, therefore, to stimulate plant growth. The potentially undesirable aspect of stimulation by the addition of these nutrients above natural levels is that fast-growth "weed species" of marine plants are favored. These plants take over an uncultivated natural aquatic system, just as fertilization on land favors weeds without cultivation to select against them.

We are examining the distribution of major forms of dissolved phosphorus and nitrogen in the Bay; phosphate and nitrate are particularly important biologically and will be discussed here. Phosphate increases from relatively constant oceanic values near 1 micromole/liter (0.03 mg/liter) at the Bay mouth to nearly 4 times this value within the Bay during the summer. In the winter, values tend to be relatively constant throughout the Bay. By contrast, nitrate values are high (sometimes exceeding 10 micromole/liter, or 0.14 mg/liter) near the Bay mouth during the summer. Nitrate values fall to near 0 within the Bay during the summer. In the winter, values throughout the Bay can exceed 10 micromole/liter. These patterns are the result of biological activity during the summer, when stream flow is low, and also stream inputs during the winter.

The phosphorus and nitrogen distribution patterns appear relatively natural and are of great interest in our attempts to better our understanding of aquatic nutrient cycling. At the spatial scale of our measurements (about 2 kilometers, down the axis of the Bay) we see no evidence for pollution effects with respect to the distribution of these nutrients. More localized sampling, for example in the shoals south of the Inverness Yacht Club, might identify small-scale pollution sources. The data base we are amassing provides a detailed water composition baseline against which more localized pollution assessments could be made and also a state-of-the-art conceptual model to describe the nutrient distribution patterns through time in the Bay.

During our investigations we have noted one aspect of Tomales Bay which has changed substantially over historical times. Comparison between bathymetric charts prepared in 1860 and 1957 indicates that the Bay has shoaled in excess of 5 m/yr. This is a rapid rate of sedimentation. The figure is equivalent to about 200,000 tons of sediment delivery to the Bay annually. Some of the sediment delivery is from longshore transport along the beach of Bodega Bay and into the mouth of Tomales Bay; over half appears associated with stream runoff. It is impossible, from the

available data, to comment rigorously on how sedimentation rate has changed over time, but it seems likely that variations occur between wet and dry years.

We know of no evidence that serious pollutants are associated with these sediments. This sedimentation therefore strikes us as largely benign--except, of course, for infilling of areas such as the southern few kilometers of the Bay. Local areas of infilling, such as behind the old railroad embankment along the eastern side of the Bay, have created small marsh areas which are now prized for their wildlife. Sedimentation within the Bay proper is at least in part a consequence of the slow water exchange which we have already discussed; sediments introduced into the Bay settle out more rapidly than they can be washed out. Thus, this high sedimentation rate reflects the potential for severe environmental degradation if more toxic or noxious pollutants were introduced into the Bay.

In summary, our work leads us to consider Tomales Bay relatively free of pollution problems associated with nutrients, at least at the scale we are sampling. That fact is a major consideration in our continued interest in the study of the Bay. However, the calculated slow water exchange rate and the observed rapid sedimentation rate are reminders that the Bay is vulnerable to environmental degradation from pollution. In having a relatively unpolluted environment, you have an unusual and valuable resource. Work hard to keep it that way.

**Moderator** We have time for some questions if anyone has any.

**Q.** I would just like to point out your definition of pollution. You're indicating that silt or sediment is not a pollutant?

**A.** No that's incorrect. What I'm saying is that I think it is relatively benign compared to many other pollutants you may be faced with. It is certainly a pollutant.

**Q.** So we conclude that we do have serious pollution in the Bay, but of a type that is sediment pollution?

**A.** That's true, but I think one of the points that we can't get at is the extent to which this is an ongoing problem or the extent to which it's something which was related to a historical event a hundred or so years ago. One thing I was struck with earlier today, was looking at this 1934 chart which happens to have an intermediate date between two other charts. It does not look like to me that it's been filled in much. Just a quick look between 1934 and now. I'm very anxious to get a copy of that chart, so I can get with an intermediate depth onto that last graph that I had, and see if there is any indication of acceleration or deceleration of infilling. Is it easy to see where the sediment is coming from and the amounts that are coming in?

**A.** Well that gets to be a very deceptive sort of figure in sense that the Bay is probably a better measure of the amount of infilling than is the water shed. The water

shed area is about twenty times that of the Bay. So you can actually hide quite a bit. I know you see evidence of erosion, but the point I'm getting at is it's very much harder to get an estimate of how much erosion is going on from looking at the water shed than it is to look at the Bay itself. You're funneling material from a very large area into a very small area. So I think the Bay gives a better clue of what is going on.

**Q.** I have a question relating to Sonoma County considering dumping their sewage out in the Estero Americano. Since the currents generally flow south, and south by the mouth of Tomales Bay, how will the dumping of that effluent affect our Bay?

**A.** I believe Tim Hollibaugh is going to comment on that in more detail, but I will speak about it a little bit and point out, I think that if there is any reason to suspect that the material they dump is going to exit into Bodega Bay still containing significant levels of pollutants in that water, it is very likely it is going to be mixed into this Bay and cause more damage here than it would in Bodega Bay.

**Q.** Could you explain the dips and valleys in your chart.

**A.** Yes let me try to do that. These dips and hills in here probably give some indication of the degree of resolution. So if you look at it from that version up there, what you see is that it looks about the same. You can only resolve so well. On the other hand these bigger features almost certainly are real features. So what this, I think is indicating, is essentially infilling associated with Lagunitas Creek. This infilling here may well be associated with material from longshore transport coming in to the mouth of the Bay. This essentially is Lawson's Landing. This I suspect is the Walker Creek signal reaching back so that it's spraying south into the Bay itself. That would be my interpretation.

Now, there's a little bit of data to support that in that, going back to a thesis written around 1960 on the effects of sedimentation on the geology of the Tomales Bay area. The author of this thesis actually thought that a lot of the material coming in at the' mouth of the Bay was coming from the Russian River. Now, regardless of whether he was correct on that or not, I would say that he was correct in concluding that there's transport from the north end of the Bay southward into the Bay.

**Q.** Is Tomales Bay a true bay or is it an estuary?

**A.** Well a bay and estuary are, of course, overlapping. facets of ecosystems. An estuary is a marine ecosystem that shows significant influence from terrestrial run-off. In that respect Tomales Bay is clearly an estuary. The fact that in summer time the salinity goes a little bit above oceanic level is a point I really didn't stress very well. This makes it in fact a particular kind of estuary which is called a negative or inversed estuary, but it is clearly an estuary.

**Q.** Don't estuaries, on the whole, show world-wide that they do fill up with sediment? And therefore, cannot sediment be looked upon as a natural phenomenon and not as something to be called pollution?

**A.** Yes, almost anything that eventually cumulates in an estuary, other than man- made compounds that are totally exogenous, are eventually sedimented in an estuary. But there is a range of rates that one might expect for estuaries in general, or for particular estuaries. And it would be my impression that the rate of sedimentation in this Bay right now is higher than the normal rate of sedimentation. I can't say how much higher because I haven't looked at it in detail. I doubt if anybody else can say either.



**Q.** Do the land management policies, particularly on the Eastern side of the Bay where there is a great deal of livestock grazing and other agricultural activities, affect the sedimentation and erosion in the Bay?

**A.** Well, clearly they do, but my impression would be that those sort of effects now are probably very localized. One thing that you should realize is that we sampled at a particular scale which, as I pointed out, is at about a one-mile spacing. So you can have local pollution sources, be they nutrients be they sediments that are finer than the grid of our sample. It is very likely in fact, that this is going on. But that is fairly small-scale pollution. I think that Bay-wide, those practices now are not causing severe problems.

One thing I might point out as a follow up answer to the question asking whether sedimentation a normal process. I know a lot of people are concerned about the wetlands around the shorelines of the Bay, particularly on the South and East shores. Those wetlands, in part of the area may have been greatly enhanced because of erosion, because of sedimentation, and the entrapment of that material behind the old railroad embankment. Now that then would say that if you are going to put a quality or value judgment on the sedimentation in the Bay, you'd have to say that there is, to some extent, a tradeoff.

There has been, at least in the estimates of some people, some good that has come to the enhancement of wetland areas.

**Q.** Couldn't surface erosion clog up a wetland system?

**A.** Yes, sure, eventually. But that is also consistent with the question as to whether sedimentation is a normal process in an estuary. An estuary will eventually clog up. It' is just, I would say, perhaps clogging up a little faster than normal.

**Moderator.** I think we'll have to bring these questions to a close because we do have other speakers with more questions I'm sure to come. Let me thank Dr. Smith for a most interesting talk.

Now I would like to introduce Tim Hollibaugh, who is a Professor of Marine. Biology at the Tiburon Center of the University of San Francisco, and who will be in charge of the next session of this program.

**PART II**  
**INVERTEBRATES**

Moderator: Dr. J. Tim Hollibaugh,  
Tiburon Center, San Francisco State University

What I have tried to do is to put together a program dealing with mariculture on the Bay and its potential for future development and its status at present. The way I have done that is to invite Mr. John Finger, who will be the next speaker, co-owner and operator of Hog Island Oyster Company, to give a presentation on oyster mariculture and George Trevelyan of Bodega Marine Lab to talk a bit about mussels, mussel mariculture, and the research work that they are doing on mussels in the Bay.

Then I am going to speak a bit about the relationship between mariculture and also the sports shellfish that are very important, particularly at the northern end of the Bay and the interaction between those resources and pollutants now present and potential pollutants largely from the proposal for the sewage outfall in the Estero Americano.

So, with that introduction, I'd like to invite John up.

**Status of Oyster Mariculture**

John Finger

Hog Island Shellfish Farms, Marshall, CA

I'm going to give a quick little talk on oyster farming in the Bay and then open it up to a few questions until Tim cuts me off and then we'll have more time for questions after everyone speaks.

Mariculture, in the form of oyster farming, began in Tomales Bay over 100 years ago when Eastern oysters were brought out by train and placed in the Bay just on the Bay bottom. In the late 1920s, the Pacific oyster was introduced from Japan. And that oyster is now the mainstay industry in this Bay as well as on the West Coast in general. Along with the Pacific oyster, we're also culturing the European oyster, or the belong (*Ostrea edulis*) and the Japanese subspecies of *Crassostrea gigas*, called the kumamoto, both of them on a limited scale.

In the early days, seed oysters were brought in from areas where they had naturally set, in the Pacific Northwest or even in Japan, and broadcast on the bottom of the Bay here. Nowadays, the industry is based around hatchery technology that has developed. We all buy seeds from hatcheries from the Pacific Northwest or Northern California. It's a much more reliable way to have a business. You don't have to worry whether Mother Nature is going to give you any seed oysters in any given year. You have them every year. Most of us on Tomales Bay use a single seed method dealing with single oysters from the very beginning instead of a cluster method. We do this because the market that is growing is for half shell oysters, where the appearance of the shell is almost as important as the quality of the meat inside.

A variety of methods are used, ranging from intertidal (putting them on the bottom) all the way to deep water methods which involve suspending trays of oysters underneath floats or underneath rafts. As I mentioned, the market is mainly for half-shell oysters and the oyster farmers on the Bay feel that it's very strong right now, due to a couple of factors. One is the

decreasing East Coast production due to their pollution and overfishing problems. Also, due to a trend in the United States for more seafood consumption.

In addition to oysters, we are also starting to look at a couple of other 'species of shellfish. A few farms on the Bay have started growing blue mussels which are naturally occurring here. They started to collect the natural seed and let them attach on ropes and suspend the ropes, again, in deep water from floats or rafts. At present, there are a few hatcheries which are starting to supply mussel seed which, again, gives a little more reliability to the business.

The mussels seem to be a little bit different in that they spawn in the winter-time which is very good considering that the East Coast mussels, which are the major share of the market, spawn in the summer-time. And, when the shell fish spawn, they are not at their peak, so that really aids in the marketability of the Tomales Bay mussels. The other thing that they have noted so far is that in past experiments with mussel culture in the Pacific Northwest, they have had a lot of- problems with first year mortality, with mussels not making it through one year. We don't seem to have that problem in this Bay which is heartening news.

Another species we are looking at is the manilla clam, which is also called the Japanese littleneck. Again, this is a species that is being raised intensively up in the Pacific Northwest but we are just starting to see the first experiments in the Bay here involving planting the clams in the bottom in plastic mesh bags.

At present there are seven oyster culture businesses in the Bay. We lease a total of 236 acres from State Department of Fish and Game in order to culture shellfish on them. To give some perspective, the Bay's total area is somewhere around 7,800 acres. In the past, as much as 1,000 acres have been in production in oysters.

To also look at the issue of leases a little more realistically, most of the leases are restricted in that leaseholders cannot cover more than fifty percent of their leased surface area with structures. In addition, there is no use that is one hundred percent usable due to either eel grass beds- or to insufficient depth from the mudflats or from siltation. Anyhow, there is, at present, a bid process going on for 562-odd acres of old abandoned oyster acreage. This is acreage that has been oyster farmed in the past, that has been abandoned by companies going out of business, and which the Department of Fish and Game has decided to reallocate out. So most of us on the Bay are bidding on trying to secure more acreage for our present operations. If the total of that acreage goes back into production, the total acreage in the Bay will in mariculture will be a little under 800 acres or about ten or ten-and-a-half percent of the total area of the Bay.

As far as our major concerns, one of our major concerns is shoreside access. As -all of you know, it is pretty limited on this Bay and it is essential to a growing oyster business to be able to have a site to load and unload, to do the processing we do,' which involves cleaning and sorting the oysters, and to store our equipment. So that's something we see as critical in the development of a viable business here. There are a few sites that can be used by the oyster business to get in and out of.

But our major concern, and one that I am sure all of us are concerned with, is water quality. Most of the people who farm shellfish in this Bay are here because of its water. quality, because it is as pristine as it is. We have to be very very aware of any sort of pollution. Above and beyond any sewage, we are also concerned with any pesticides introduced into the Bay and any adverse siltation which can really affect anyone's lease or make it half unusable.

I know this subject is going to come up a lot today, but as far as any sewage treatment project anywhere around Tomales Bay that might have the slightest possibility of impacting the Bay, we are extremely, extremely wary. If there was to be a mistake or to be a contamination in this

Bay, the Bay might recover, our oysters would recover, they are amazing little filters. But the industry, with the negative publicity that would be generated by something like that, would probably never ever recover.

If there are any questions, I'll take some now.

**Q.** What about the proposal that has been made for deputation, for bringing oysters from contaminated water to this Bay. What effect does that have on you?

**A.** Depuration, for anybody who doesn't know, involves setting up a tank system whereby you purify the water and, because oysters and shellfish in general are very good filters, you can put the shellfish in the system and they will purify themselves of organic contaminants.

If you are talking about relaying from outside this area to this area, I would hope not to see too much of that. I don't think economically that's very feasible so I think that would deter most of that from happening. If there's a viable industry happening here where we can produce shellfish at a certain price, it is going to be very hard for someone who produces shellfish in Sari Francisco to compete, if they have to truck their product up here to deputation plants, not to mention overcoming the additional stigma attached to their product that it all has to go through a deputation plant.

**Q** No, I meant just put them in the Bay until they cleanse themselves.

**A.** Yes, again I think that the biggest consideration that would keep that at a minimum, if it happens at all, is economic. Once an oyster is market size, you don't want to be moving it too many times. If you've got to move it up here and then move it back down, it's going to be hard for someone like that to compete.

**Q.** I was just wondering what your estimate was on what the growth, in terms of quantities of shellfish that are being produced now and in terms of the value of that crop and what you project with the addition of 500 acres.

**A.** That's hard to project. Everyone isn't really open about those figures, as you might imagine.

Comment from Audience The production in 1987 was about 800,000 oysters.

**A.** In 1987 the production was under 1,000,000 oysters. That's going to go up even without the leases that are coming into being, that figure is going to go up by ten or fifteen percent easily. I should emphasize that not all these new leases that are coming up for grabs are very usable, so even though it looks as if we are adding another double the amount of acreage that's currently in use in the Bay, you should realize that part of the reason that some of these leases were abandoned before is that they are not as good as they are all cracked up to be. So, 562 acres might translate into another 300 usable acres.

I would imagine, long long range, we should see a doubling to a tripling of the number of oysters grown. Again, you should realize that this probably doesn't even come close to what was once grown in this Bay.

**Q.** Does the industry have any plans to work with the State in this new lease that's pending to deal with the problem of abandonment with all of the equipment etcetera?

A. Yes, the way Fish and Game law reads is that when you abandon a lease, you are supposed to take all your equipment with you. As anyone who is familiar with the Bay should know, that has not always happened before. That's as much a problem for me as it is for you. If I want to pick up one of those leases, I've got to go in there and move old equipment out of there because it's not going to do me any good sitting there.

What they are doing now is becoming a little more stringent in the whole lease application procedure. You have to show that you have been in this business for a while, that you have the capability to produce, and they are also talking about the possibility of a performance bond and first and last year's rent, which was never required before. They are making it a lot stiffer so that they might have some money in their coffers if they need to go in and clean something out when it is all over. Thanks.

Dr. Hollibaugh: Our next speaker is George Trevelyan of the Bodega Marine Lab who will address the question of mussel population and mussel culture in the Bay.

## **Ecology and Cultivation of Mussels in Tomales Bay**

George A. Trevelyan

University of California/Bodega Marine Laboratory

Thanks, I am going to go into a little more depth about the mussels in Tomales Bay that John touched on. I am going to first talk about the mussels we have here in Tomales Bay, their life history and then going to some of the farming practices that are going on and that are developing in our Bay.

Mussel beds are one of the most productive communities on earth, rivaling tropical rain forests and kelp forests. The matrix of a mature bed is the home of a complex community of associated organisms. The mussels themselves are an important food source for many species of invertebrates and vertebrates, including man.

There are two large mussel species on the Northern California coast. The surf mussel, *Mytilus californianus*, forms large deep beds on exposed rocky shores, but does not penetrate far into Tomales Bay or other protected bays. On the other hand, the bay mussel, *Mytilus edulis*, is abundant in parts of Tomales Bay and is the subject of a small fanning industry. Along rocky shores, such as those near Marconi Cove, bay mussels form natural beds in the intertidal zone. The west shore generally has larger beds than does the east shore. Bay mussels also occur opportunistically on man made surfaces such as docks and rafts. Is this mussel a native of Tomales Bay? Recent evidence provided by McDonald and Koehn (1988) suggests that no, this mussel may be introduced.

Whatever its history, this species is now well established here. The adults are of separate sexes and they must spawn their gametes simultaneously into the water where they fuse to form embryos which develop into microscopic swimming larvae within a day. These larvae remain pelagic, feeding on phytoplankton, for 3-6 weeks. The mature larva then settles onto filamentous or rough substrata and undergoes metamorphosis into the juvenile form. I have observed settlement to occur in Tomales Bay between February and April. Within a year the young mussel can grow to 7 cm in length.

One aquaculture company (Cove Mussels Co) to date has specialized on this productive resource in Tomales Bay. The -seed mussels are collected and are stuffed into net socks which are tied to a series of long lines in Tomales Bay. One constraint on this activity has been shortage of seed.

I have spent the past several years developing a hatchery approach for the production of seed. The hatchery produced spat are transplanted into the bay at a small size (0.5-3 mm) and are grown out on a variety of materials. There are many consumers of mussels, and this project has brought them all out of the woodwork. When the mussels are still small (< 12 mm) they are preyed upon in the spring by flatworms, *Notoplana inquieta*, and in the summer by seasonably abundant populations of surfperch, mainly shiner perch, *Cymatogaster aggregata*. As the mussels grow, red rock crabs, *Cancer antennarius*, can be important predators. The most important predators however, are the overwintering populations of surf and white wing scoter ducks, *Melanitta* spp. One, and maybe the only, effective and environmentally sound method of dealing with these birds is to grow the mussel crop inside cages or nets of some kind.

As with oysters, mussel farming is completely dependent on very clean water. If aquaculture is to flourish, high water quality has to be strictly maintained. Thank you. Any questions?

**Q.** I was concerned about whether or not there was any use of chemicals such as TBT to keep down the algae. Is there anything like that going on with the mariculture?

**G. Trevelyan:** No, there isn't. TBT is extremely common toxic to shellfish. There is a classic conflict in the Pacific Northwest between shellfish growing and salmon farmers over that issue.

**J. Finger:** In the Pacific Northwest, the typical way to grow salmon in pens is to use netting that has been treated with TET and that has wreaked havoc on the oyster industry in addition to the naturally occurring populations. And so, in bivalve culture, TBT is really avoided and we hope that that doesn't become a problem. Yes

**Q.** In Tomales Bay this past summer, it has been apparent at low tide that the mussels, at least on the West side of the Bay, have not grown at all. Also this summer there has been a great increase in the green algae. I wondered if you had any comments on that.

**G. Trevelyan:** I've grown mussels this summer in Marconi Cove and they have grown rapidly. I haven't gotten over to the other side, so I really don't know. Yes.

**Q.** Mussels get harvested at nine months. Is that because they don't grow any bigger or because the growth after that isn't economically viable?

**G. Trevelyan:** They usually get harvested after about a year, but nine months is a minimum. They will continue growing rapidly for several years. So the time of harvest is dictated partly by what the consumer wants. People tend to want a smaller mussel as opposed to a big giant.

**Q.** Are any of the inadvertently introduced predators, like oyster drills and whatever ones there are, causing problems for the industry?

**J. Finger:** Those haven't been a problem. There is a flatworm we thought might be introduced, but it's a native species. Since we are drawing mussels off the bottom, then benthic, or bottom-dwelling, oyster drills are not a problem. There were two species of oyster drills introduced, one from the East Coast and one from Japan. They are fairly abundant but they are not a problem to mussel culture.

**Q** How large do these two different species of mussels get and are they still pleasant to eat when they are large?

**G. Trevelyan:** Yes, they are still good to eat at any size. It is just what people prefer and generally people prefer bite size. The California Outer Coast mussel gets to be at least one foot long. The bay mussel is maybe a little smaller but I have seen them very large, maybe eight inches.

**Q** Are there regulations and guidelines for mussel and oyster farming.

**G. Trevelyan:** Yes, I am not a commercial farmer so I haven't had to go through the whole regulatory procedure but there are a lot of agencies.

**J. Finger:** It took me about a year to get all the permits necessary to do this. The problem is that Fish and Game is the lead agency but there are about six or seven agencies that you have to go through and get permission before you can start operating a mariculture lease.

**Q** Do they monitor the farming as it is going along?

**J. Finger:** The only monitoring that really goes on is a little bit from Fish and Game to see if you are using the methods you say you are going to use and from the State Department of Health who monitor the water quality and make sure our product quality is up to standard.

**Q** What about mussel contamination and quarantine? I believe that is not a problem in the Bay?

**G. Trevelyan:** Yes, one of the positive aspects of growing mussels here is that there have been few of the problems that they have encountered up in Puget Sound, for example, and one of those is Paralytic Shellfish Poisoning that can be really common up there and also on the Outer Coast. For some reason, the algae species that causes that doesn't penetrate far into this Bay.

Cove Mussel Company has been selling their mussels every month of the year because they send in samples weekly to have them tested and they come out clean every time. But still, to be on the safe side, you shouldn't eat them in the summer unless you know they have come from a certified area.

**Q** Could you talk a little more about Paralytic Shellfish Poisoning and the research that is being done on the subject?

**Dr. Hollibaugh:** Paralytic Shellfish Poisoning (PSP) is caused by a toxin produced by a dinoflagellate, *Gonyaulax*. Nobody knows quite why this particular organism produces the toxin. Not all species of *Gonyaulax* produce it and not all the strains of the species that are found to be toxic are always toxic. So there's a lot to be learned there. There is active ongoing research on the question. A significant fraction of that research is concentrating on efficient ways of monitoring it. Presently what they have to do is take a sample of the shellfish, grind it up and then use an experimental animal that will respond to the toxin to find out if there is toxin in the extract.

Now what it does is that it paralyzes the peripheral nervous system. It starts usually at the extremities and then works in with a gradual paralysis. Death occurs due to suffocation generally because you just can't breathe. The sympathetic nervous system stops working and you effectively suffocate, so what they do is put people in heart lung machines. If they survive that, usually there are no after-effects.

It's rare in Tomales Bay, as George said. It's common on the Outer Coast. The Outer Coast mussels are quite good. I've eaten them on a number of occasions. But it really is playing Russian roulette to go out there and pick mussels unless you are very positive that those mussels are safe. For some reason that no-one quite understands, although it has to do with the mussel's physiology, mussels accumulate the toxin a lot more rapidly and at a lot higher concentration than many other shellfish, particularly oysters. That is why oysters are used as the preferred monitoring species by the Department of Public Health. So if this algae is in the water producing toxin, the mussels will



show it first. You can have oysters sitting right next to them that will be unaffected and won't show any toxin present. This has happened out at Johnson's Oysters on a number of occasions.

Now, other shellfish are also affected, mainly clams. Washington clams, for instance, are notorious for picking it up and they tend to hold it for a long time. So if you have an incident of Paralytic Shellfish Poisoning over a clam bed where the mussels will clean out in about a week after removal to water that doesn't contain any of this algae, the clams are reported to hold it up to two years in areas up in Alaska and British Columbia. Leo Cronin I've tested mussels and clams and found sometimes fecal conform as high as 32,000 mpms but that's always at the south end of the Bay. Is there any conform, either fecal or common as high as 100 down this way in the Bay?

**A.** Yes, Walker Creek, pretty much anywhere along the Bay during run-off, there are a few coliform bacteria in the water that show up in the mpm intensity that you are talking about.

The Department of Public Health has monitored a number of sites in the Bay, usually for not a very long period, and they have come up with guidelines which they feel are safe as far as the cleaning out of the Bay. So they will monitor sites on the Bay and, after a certain amount of rainfall, will have found x number of fecal conform bacteria in the water and then follow, as that rain event decays, the decline in fecal conforms to some level that they decide is a safe level. As a result of those studies, they put limitations on harvesting so that the growers in the Bay are not allowed to sell product out of the Bay following rainfalls greater than half an inch (and it varies a little bit from location to location in the Bay) for four to five days. And then, if you have another rainfall during that period, then you start the clock back over.

The problem is Bay-wide. It tends to be worse where a lot of streams enter the Bay because most of the fecal coliforms appear to be coming in off the land.

It happens quite often that where mussels occur naturally to find everything stripped completely clean both out at the Point and in the Bay. Are there any limits on harvesting the naturally-occurring mussels? And is over-gathering a problem?

**G. Trevelyan:** The limit on mussels is 10 lbs. per day which translates into about one bucket of mussels per day on the Outer Coast. That applies to the mussels here in the Bay as well. There has been a problem where people have ripped up whole beds of mussels. But it's not generally a big problem.

**Dr. Hollibaugh:** One of the problems, particularly with Outer Coast mussel beds, is if you disturb it, and it's like a nylon sock if you start a run, and you have moderately heavy storms that winter, the bed tends to anchor itself down. If you give the waves the chance to get underneath and lift it, you can have large patches being peeled off by wave action due to a relatively small initial scar.

There's a large body of ecology out of the University of Washington that has studied the effects of big drift logs smashing into the Outer Coast mussel beds up in Washington State. What they have found is that, although you have got an area where the logs smash and kill a group of the mussels, frequently the scar area is much larger because once the tear has been introduced, the wave action will then rip it off to some natural anchor or boundary where the bed is a bit more protected. And it will take some period of time for that scar to heal back over.

**G. Trevelyan:** On the Oregon Coast, there are some commercial harvesters who have been taking the surf -mussels and creating large open patches. When you do that, you also take all the baby mussels that live down amongst the big ones. The preferred way to harvest them is to take the big ones out but to hold the mat in place so that the small ones just move in to take space of the bigger mussels.

**Comment from the Audience** I'd like to clarify something about the limits that you gave. The Department of Fish and Game limits on commercial harvesting (as opposed to sport harvesting) of mussels is 250 lbs. for the big ones, the horse mussel. There is no limit commercially on the harvest of the small bay mussels.

**Q.** Did you say that the mussels that we have here in the Bay are the same species that are in the ocean? We live on the Bay here and our mussels never get over a certain size over a period of years. If they were the same species, I would think that they would eventually grow to a large size the way the mussels are out in the ocean.

**G. Trevelyan** No, they are two different species. The ones on the Outer Coast are definitely a different species. The ones inside the Bay are usually no more than about four inches in length but I have seen a few that are really lot larger than that. But you are right. It's rare.

**Q.** I've only lived on the Bay for about 12 years, but I have been told by old-timers that the native cockle and the horseneck clam both were much more prolific several years ago. Is there anybody who has documented this? Is this true or is this just folklore?

**Dr. Hollibaugh:** Dr. Hedgepeth, you could perhaps address that question. What I've noticed in the Walker Creek mudflat is that there are two- or three-year cycles in some of these species. For instance, there used to be a lot of horsenecks down there just after the 1982-'83 flood. For a while they were all over the place. You can't find them down there now. A combination of clam-diggers, old age and bat rays have apparently eliminated them and for some reason they have not been recolonized. The Fish and Game people could probably invent some catch numbers for the Lawson's Landing area, but there are not any ongoing records of that sort for the native species.

**Dr. Hedgepeth** We never have had good records. It's rather hard to census clams anyway. When you start digging, the danger of smashing up the little ones on the way is pretty severe. I did notice one year that there was a massive set of the bay mussel outside the Bay. I know that at Dillon Beach the rocks were covered with little mussels about 1/2 inch long. I know that the bay mussel has a much weaker byssus (thread to hang on with) than the ocean mussel, obviously. Presently the big fellows began to settle in and grew faster and they simply crowded these out.

**Shellfish as Indicators of Water Quality**  
Dr. J. Tim Hollibaugh  
Tiburon Center, San Francisco State University

I want to briefly address the issue of toxic compounds that also affect the oysters and mussel industry as well as the sport fisheries in the Bay. This might affect both the shellfish industry and those interested in recreation.

There's already fecal coliform contamination in the Bay. The sources of that are hotly debated and I don't want to get into the middle of that debate right now. A more insidious long-lasting problem would occur if the Bay got contaminated with toxic substances, such as metals or some of the bi-products of various industries.

And so it was with alarm and surprise that I learned that the City of Santa Rosa's presently revised plan was to dispose of sewage in the Estero Americano. They apparently preferred this over other sites, probably because they didn't expect any opposition, because there aren't too many people living on the Estero Americano.

Based on ecological considerations, it's worse than the other alternatives they proposed. The reason for that is that the Estero Americano, much like Tomales Bay, is going to track any of the contaminants that come out into Bodega Bay. The disposal plan is to dump water containing whatever it may contain--we're told it's going to be EPA- quality drinking water, except they're a little bit worried about some of the metals--into the upper regions of the Estero Americano through some sort of a spray field and marsh recreation or restoration plan. This water will then mix with the water in the Estero and flow out its mouth into outer Bodega Bay.

Along with the water there will probably be viruses, bacteria and toxic substances. The treatment that is generally used on sewage can take care of the bacteria. There are frequently failures at the plants which result in the discharge of untreated sewage. Currently the City of Santa Rosa has a large reservoir, which can hold water for something on the order of 90 days, assuming it starts emptying. After that point they have no more storage capacity. That's what happened two years ago when, as a result of lack of storage capacity, they discharged into the Russian River.

Now they have to discharge somewhere else; in this case it will be the Estero Americano. It will take some period of time for that water to flow down the Estero and reach outer Bodega Bay. During that time it's probable that most of the fecal conform bacteria will be either be consumed by natural processes or be diluted to a point you won't be able to detect them at the mouth of Tomales Bay.

The viruses and the toxic materials, on the other hand, present a completely different problem. They tend to be surface active in many cases, or to undergo chemical reactions in seawater that convert them into a particular form, which then can exchange with water at a later date, depending on changes in the water chemistry.

One of the substances of concern is copper. Copper, upon reaching seawater (which has a relatively high pH), forms an inorganic precipitate. It will settle to the bottom or adsorb on particles and be trapped as long as the water column remains oxygenated. At the point that the water column becomes de-oxygenated or that these particles become buried deeper in the sediments, these toxic metals desorb and become soluble in water for a time. If something then disturbs that sediment, for example as a sting ray, a major flood, or dredging, the metals then become liberated to the water column and move out with the current. These particles will gradually progress down the Estuary and into outer Bodega Bay, where they will, in general, be transported south.

This flume you see offshore in this aerial photograph originates at the Russian River. This is Russian River sediment that has come down hugging the coastline from the Russian River and in this case it happens to be a little bit outside of Bodega Bay, but in other photographs it sort of swirls around Bodega Head and comes into Bodega Bay. The point of this is that these particles, once they are introduced into the Ocean, can travel quite a long way.

It probably will take a while for the concentrations of substances in the Estero Americano to build up, barring major breakdowns at the sewage treatment plant proposed by Santa Rosa. But gradually over time, the Estero Americano will load with these materials which have the possibility of being transported down the Estero, into the coastal zone, and then being trapped in the outer regions of Tomales Bay. So this is something that the mariculture industry in the Bay is concerned about and, as a scientist, I think that is a very realistic concern.

One of the other problems is that the mariculture leases here are for twenty-five years but the plan for the sewage treatment plant is only for ten to fifteen years. Sonoma County has shown no particular signs of controlling growth. So over the twenty-five years of a mariculture lease, two things can be expected to happen. First, the population of the Santa Rosa area is going to increase and there are going to be many more hook-ups on their sewage system.

Second, the industrial base, which is now relatively non-toxic in that area, is going to alter. One can envision the City of Santa Rosa and others attempting to attract (and probably successfully so) many of the Silicon Valley-type industries, which produce large numbers of hazardous substances which have been partially responsible for severe contamination of the South San Francisco Bay.

So while the plan right now seems like its going to have relatively little impact, the concern is for the longer term and the future development. Thank you.

**Moderator** We have about five minutes to address questions to any speakers that have spoken so far. Then I understand there is a break.

**Q.** My question is whether or not the actual presence of oyster culture and oyster culture structures is actually causing more siltation?

**J. Finger:** My feeling on the matter is that, first, silt is coming from the land; it is a process that in some form is happening naturally. I haven't been here long enough to know if it's speeding up all of a sudden and happening faster than it used to. But I have seen the Bay dramatically silting since I've been here, whether on areas that did or did not have structures on them.

Second, we're restricted on how much of the area we can cover with structures. If you put solid oyster racks in front of a current that's carrying silt, that current is going to slow down and the silt is going to drop out. I don't want that to happen because I'm going to bury my oyster racks, but in addition to that, we are regulated by Fish and Game, the Coastal Commission and Marin County. We have to provide a plot map of how we're going to plant that lease and it has to fit in with the total area coverage and the orientation of the structures.

**Q.** I'm a little concerned about the present oyster leases given out. It seems to be unfair to the mariculture people to be bidding on sites that are certain to meet resistance for one reason or another.

**J. Finger:** The question was regarding some of these new leases coming up for bid, and the fact that in the Local Coastal Program between the Coastal Commission and the County, there were guidelines set for areas to be used for mariculture, and areas set aside for recreational use. In the deeper water that does make a difference. Most of the parcels that are being used presently and that are coming up for bid on the East side of the Bay are mostly in very shallow water.

(Pointing to chart) This particular lease that you are concerned about, just north of Marconi Cove, is not a new oyster lease.. It has been an oyster lease before and there was a time when there was an opportunity to comment upon and oppose that lease.

**Q.** I've discussed it with some local fisherman and they're really concerned. I just was concerned about Fish and Game's approach to this because the Local Coastal Plan does specify that before abandoned parcels are re-leased, that they will be reviewed.

**J. Finger:** You are assuming that if I get one of these leases I'm going to have to go through the same review process I went through when I originally got my lease. Remember that if all these leases do get re-acquired, there will be a little under 800 acres out to lease. Out of that I would say the vast majority is intertidal, which means it's very, very shallow water and not suitable for recreational boating. There might be 20 acres in the Bay that are deeper water leases, the other 780 acres or so are all in shallow water.

**Q.** Is it considered private property?

**J. Finger:** No, I have to allow access. We are supposed to allow recreational clamming. I can't stop anyone from coming- in and digging clams that are near my oyster racks.

**Q.** I just think it's a pretty good idea that we all start thinking about the development of water areas, such as this Bay, by looking a little bit at the history of the land areas. There are all different competing uses going on in land areas. We knew that we finally had to go to a planning process to look at all of these land uses and to decide which ones we wanted.

It's the same thing with the Bay. I think it's absolutely ridiculous to be thinking in terms of issuing these oyster allotments immediately without looking at the full picture of all the different uses of the Bay and how they compete. Likewise in the Estero Americano, I think it ridiculous to consider dumping pollutants up there without looking at the long range picture of its impact on the coastal area's future?

**J. Finger:** I would just like to add that I'm coming across biased on this one. I've gone through a familiar process which took me a year to get a 5-acre lease. These leases have been through this process at least once before. So we're not talking about doing anything that has not been discussed before in the Local Coastal Program, but I realize the concern.

**Q.** I want to say I'm well aware of this. I worked for the Department of Fish & Game for twenty-five years. I've been doing this kind of work for the last forty-five years. The fact that oyster leases were issued previously doesn't mean that they shouldn't be looked over carefully when coming up for renewal now to see if they conflict with other more important uses. I'm not speaking against the shellfish culture in the Bay. I'm just saying you should look at all the uses. Any other questions?

**Q.** I was wondering about the various varieties of clams which one digs in the Bay? Are any of them introduced and are we likely to see more introduced species as the result of some being farmed in other parts of the Bay?

**A.** I'll answer this very briefly. Again Dr. Hedgepeth can probably answer this much better than I can. I believe the major introduced species are the softshell clam, which is not particularly abundant, and the manilla clam which again is not particularly abundant. The major native species are the cockle, the gaper and the Washington clam, also called the butter clam. Am I right or wrong or am I pretty close?

**Dr. Hedgepeth:** Pretty close. The so-called manilla clam is almost identical to the native rockcockle and tends to replace it. Ecologically there is very little difference. The Japanese clam has got more purple on the edge. It's easy to tell because it is a little more oval and purple in shape inside.

The real danger comes partly from such activities as deputation. You've got to be very careful that you don't bring in the wrong thing when you bring oysters into the Bay for deputation. We have just now got a new episode in San Francisco Bay which is full of all sorts of things, something like 250 introduced species, most of them of no great significance to us one way or the other scientifically. But we do now have a little clam about the size of an almond, or your big thumb nail, that has just come in. It's called a *Corbula amurinsas*, from the Amurin River in Siberia and this crazy thing thrives in fresh water and also lives in salt water (up to 32 parts per thousand). It's just exploded in San Francisco Bay.

I don't think you really need that in Tomales Bay because of the limited space if nothing else, and we don't know what this clam may bring with it; it may have harbored some other interesting commensals; it may or may not be good for the rest of the species, to say nothing of us. This is a real danger for introductions are upsetting the native ecosystem. I would hate to see it in Tomales Bay.

It will probably cause us a lot of problem in San Francisco Bay. It may be an intertidal feeder on the plankton used by other species. We just don't know yet; we have suddenly just had an instantaneous explosion. It's very interesting scientifically but it's a matter of concern to watch very carefully what you bring into this Bay.

One of the habits of anglers is that they catch an interesting fish and say, "That looks like an interesting fish. Maybe I should use it for bait." They will then move it around contrary to all of the Fish and Game laws.

**Dr. Hollibaugh:** Thank you Dr. Joel Hedgepeth.

**PART III**  
**VERTEBRATES**  
Carl Munger, Moderator:

The first speaker in this section is Dr. Jon Shenker from the Bodega Bay Marine Lab. He's a Biologist and an Oceanographer at the same time, from Oregon State University. He's been in Bodega Lab for three and a half years. His major research is in marine pollution and in recruitment processes, which means the survival level of the larvae as they move toward the adult stage.

**Marine Fishes of Bodega and Tomales Bays**  
Dr. Jon Shenker  
Bodega Marine Laboratory, University of California

Thank you very much for inviting me here today. I've found this a very informative meeting so far. I've learned a lot and I hope to continue learning, as I hear additional speakers talk this afternoon. One thing I would like to do while I'm here today is also learn from you folks as much as possible. It has been indicated that I have been in the area for a little over three years now. I still have a lot to learn about the Tomales Bay region. And in our discussions later on this afternoon, if you have some more tidbits about fish and anything else I'd be more than happy to talk with you.

Now I would like very much to be able to sit up here and give you a definitive statement on the state of fishes in Tomales Bay. We do know there are over a hundred odd species that have been found in the Bay, either very frequently or periodically, but unfortunately there has been very little systematic study on the fish population in Tomales Bay.

Accordingly, I'll just present some of what we do know about the commercial species and some of the more important noncommercial species and briefly describe the Bodega Marine Laboratory Research projects that are being conducted here in Tomales Bay. As I said, later on I would also like to be able to hear from you about other aspects of fish biology that I am not going to be touching on, here today.

Let me just start off by briefly describing the general role of Tomales Bay in the life of fishes. There are essentially three basic types of life history patterns in the utilization of Tomales Bay. By a life history pattern we mean, where the adults go to live, feed, spawn, how the larvae makes it back to the nursery area, and so on. One of the main types of life history patterns we see here is the year-round resident that lives and spawns in Tomales Bay or Bodega Bay, (which is very similar in many respects, and even includes a lot of the smaller local fish species, such as the surf perches)

We got to see some of them earlier in George Trevelyan's talk, eating all of his baby mussels and other animals that are not readily seen, such as the gobies or sculpins, (very small little fishes that tend to live in and around oyster shells on the bottom or build holes in the mud and so on). These tend to be year-round residents that live and spawn in Tomales Bay. Sometimes the larvae gets washed out of Tomales Bay and then they have to ride oceanographic currents to get back in.

A second type of life history pattern you see here in Tomales Bay is the seasonal residents. They come into the Bay primarily for spawning. These are fish species like the steelhead trout,

which spawns up in Walker Creek, for example. As the eggs and larvae hatch, the juveniles move further down the stream into Tomales Bay and go out into the open ocean, grow into adults and then they return back to Walker Creek for spawning when they are adults. Other fish that do this, of course, are the herrings. I'm sure you are all familiar with the Pacific herring. It is an important fishery species here in Tomales Bay.

And finally a third type of life history pattern is represented by the coastal and oceanic fish that periodically move in and out of the Bay, primarily to feed. These include a lot of the sharks you see here in the Tomales Bay region. Most of the known information comes from the California Department of Fish and Game and I'm indebted to Phil Swartzell from the Menlo Park office for providing some of the information I'll be showing to you'. Now, if I can get someone to turn on the slides, please.

<b>FISHERY LANDINGS IN TOMALES BAY</b>		
<b>SPECIES</b>	<b>TOTAL CATCH</b>	<b>TOTAL VALUE</b>
	<b>1978-1987</b>	<b>1978-1985</b>
	(thousands of pounds)	(thousands of dollars)
Pacific Herring	10,561	4,393
Sharks	209	85
Halibut	17	29
Surfperch	23	12
Jacksnelt	4	2
Smelt	1	0.5

**FIGURE 1**

From Phil Swartzell's information on fishery landings on the Tomales Bay region I summarized the amount of different fish species that have been caught commercially and have been sold on the open market. You can see that the Pacific Herring constitute the biggest fishery in Tomales Bay (Figure 1). The first column shows 10,500,000 pounds of Pacific Herring that have been caught in Tomales Bay over the 10-year period. We don't have the evaluation for the last two years but basically it comes up to over \$4,400,000 just simply from this small Bay alone. That far and away exceeds the commercial value of other Tomales Bay species.



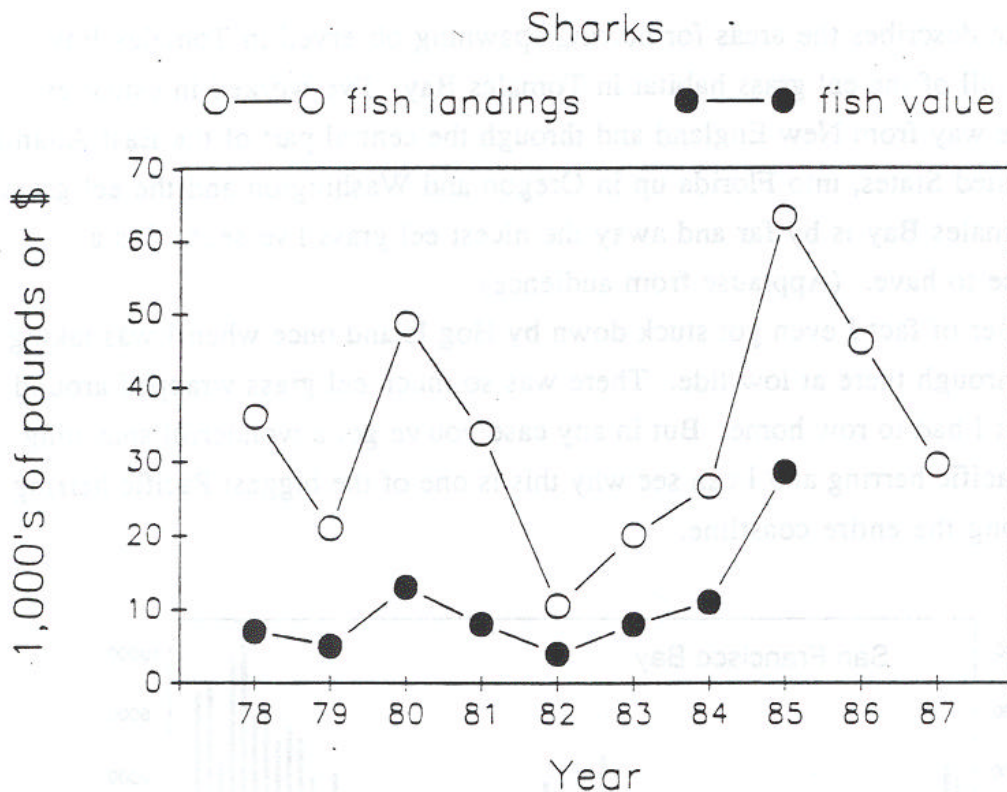


FIGURE 2

Sharks constitute the next largest commercial value of fish from Tomales Bay and, in that case, only 210,000 pounds have been taken over a ten-year period with a value of about \$85,000 (Figure 2). So compared to the \$4,400,000 dollars you see for herring, sharks are relatively unimportant.

Halibut have also been taken in the Bay and out in Bodega Bay. Surf perch, jack smelt and regular smelt have been taken periodically and sold. There is a small market for these fish species in Chinatown and several other areas in the San Francisco Bay region.

Let me concentrate a little bit more on the Pacific Herring. It can grow up to about 18" inches in length, but typically it's quite a bit smaller than that. I noticed at the table coming in that there is a book on Pacific Herring. It was written by Ann Suer. It is an excellent summary of the Pacific herring fishery. I'm going to show you a few slides that I photographed out of her little booklet.

The Pacific herring moves into Tomales Bay generally in the late winter and spawns in December, January and February or thereabouts. They spawn mainly on the eel grass habitat. They swim down to the bottom in great big schools and all of the males and females release their gametes pretty much simultaneously. The females put their eggs right on the eel grass or other submerged vegetation. When the larvae hatches it will now survive in that environment.

This slide describes the areas for herring spawning observed in Tomales Bay. Basically this is all of the eel grass habitat in Tomales Bay. I've worked in estuaries extending all the way from New England and through the central part of the East Atlantic Coast of the United States, into Florida up in Oregon and Washington and the eel grass seen here in Tomales Bay is by far and away the nicest eel grass I've seen. It's a valuable resource to have. (Applause from audience)

As a matter of fact I even got stuck down by Hog Island once when I was taking my small boat through there at low tide. There was so much eel grass wrapped around the propeller that I had to row home. But in any case you've got a wonderful spawning habitat for the Pacific herring and I can see why this is one of the biggest Pacific herring fishery areas along the entire coastline.

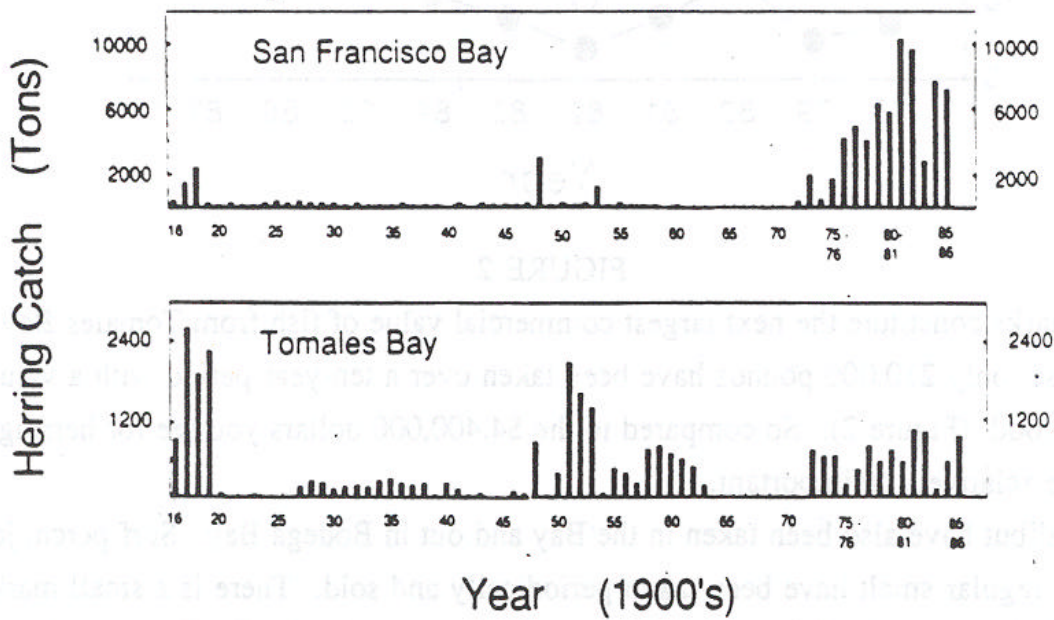


Fig. 4: Herring catch in San Francisco and Tomales bays. Prior to 1972, values represent annual catch. Thereafter, values represent seasonal catch. Beginning with the 1978-79 season, Tomales Bay and Bodega Bay catches are combined.

### FIGURE 3

This figure (Figure 3) demonstrates the amount of herring taken since the early 1900's. This is Tomales Bay and San Francisco Bay and this is tons of herring per year, here on the left side it starts around 1916 and goes all the way up to the 1980s. You can see several major peaks and couches. These peaks and couches are due primarily to changing of fishing effort, not in actual abundance of the stocks over time.

On the far left side, for example, we see the big peak in the teens. That is primarily due to a major fishery that occurred during World War I but it's a lot of effort to pickle these herring and use them for food throughout the United States. Right after that, the fishery dropped off dramatically. Part of that was due to legal regulations that went into effect, to prevent taking of herring and

grinding them up for fertilizer. It was not felt that fertilizer was an appropriate use for the fish species, so regulations were established that said you could only catch them for food.

Again they had another increase in fishing effort in the mid 50's and 60's, where they tried several other different things to make herring palatable to the American public. They succeeded for a little bit but not too terribly much, and the fishery tapered off again.

It wasn't until the early 1970s that events on the opposite side of the world would cause a dramatic change in the fishery here in Tomales Bay. The Japanese have a very strong yen for herring. They like to eat the roe. They pick the roe sacks out of the herring and it's served as quite a delicacy in Japan. The Japanese were taking most of their fish from the Russian coast. In 1972 the Russians closed that coastline to the Japanese fishery. That immediately triggered the growth of the herring fishery here in San Francisco Bay and Tomales Bay. All of the fisheries we've seen since then has been due primarily to the Japanese market.

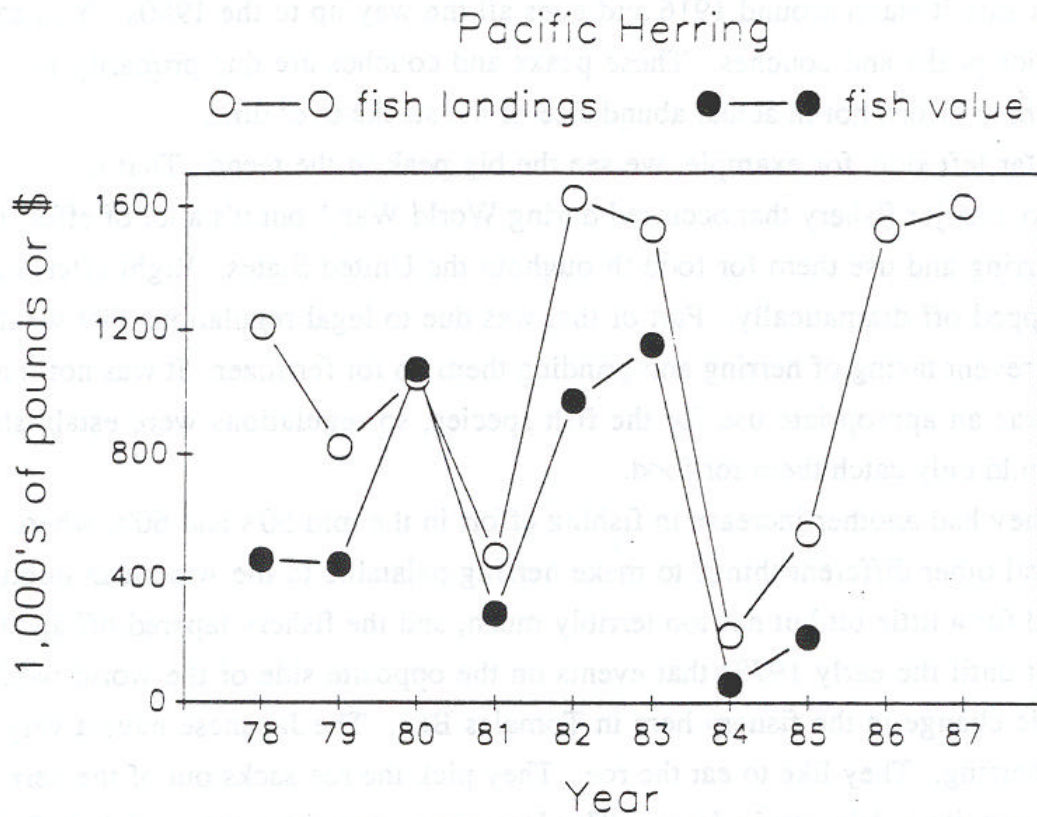


FIGURE 4

One figure here from the California Fish and Game Regulations data demonstrates the fish landings and the value of herring that have been taken here from Tomales Bay since 1978 (Figure 4). The numbers on the bottom covers two years (1978-79). You can see again that there is quite a variation in the terms of the fish landings. There's thousands of pounds on the left hand side of the scale and you can see that in some years, the fish landings went up to almost 1.6 million pounds of her- ring in a single year, just from this one little habitat.

Subsequent years, particularly 1983-84 showed a dramatic decrease. That decrease in 1984 can be attributed to El Nino causing very slow growth in the individual fish.

El Nino didn't seem to put a permanent crimp in the herring fishery though, and the stocks have rapidly rebounded in 1986-87. The annual value of this fishery can reach as high as \$1,200,000. Again simply for the fish, caught in Tomales Bay area.

Well, that's in terms of landings but how many fish are really out here? The Fish and Game have set up a herring project that estimates the numbers of fish in the spawning population. They did this fairly simply by going in and counting or estimating the number of eggs present in one year. From that information, knowing how many eggs a single fish can produce and also knowing how many fish were caught, they can calculate the size of the population that was present to lay those eggs. They then use that to establish the number of fish that can be caught in subsequent years.

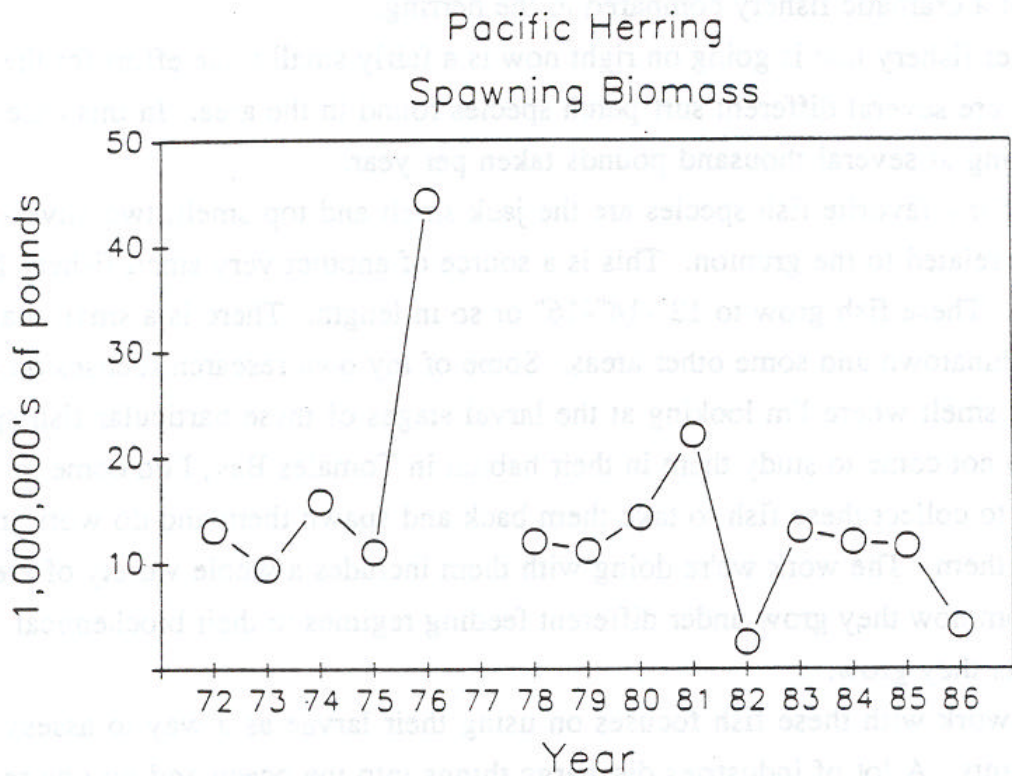


FIGURE 5

This diagram (Figure 5) shows you the estimated spawning biomass or how many herring they figure are out there that can be taken. They define the allowable catch for subsequent years to be about 20% maximum of what had been there the previous year. Again you can see some pretty dramatic fluctuations occurring, particularly in the mid to late Seventies when you had a huge population of herring move into Tomales Bay. There were nearly 50 million pounds of live fish swimming around in this one Bay during the spawning season at that time.

So again you can see tremendous populations going up and down and these seem to be more of a natural population fluctuation than anything induced by man's activities.

Some of the other fish species I'm just going to talk about very briefly. I mentioned the shark fishery, the next largest fishery in Tomales Bay compared to the herring. The Pacific angel shark can occasionally be collected. Most of the fisheries prefers the brown smooth hound. There are other shark species, such as leopard shark and thresher shark. The threshers are taken primarily offshore

These are the shark landing values. You can see that in some years it went up to about 60,000 pounds of sharks, in a single year. Most of them are taken in Tomales Bay, but this does include some figures for fish that were taken outside of Tomales Bay and then landed here in Tomales. The value of that went up to about \$30,000.00 per year at maximum. So again, this is a significant fishery for the few fisherman who are involved in it, but it is not a dramatic fishery compared to the herring.

Another fishery that is going on right now is a fairly small scale effort for the surf perch. There are several different surf perch species found in the area. In this case we are only looking at several thousand pounds taken per year.

One of my favorite fish species are the jack smelt and top smelt, two silver-type fishes closely related to the grunion. This is a source of another very small fishery here in Tomales Bay. These fish grow to 12"-14"-16" or so in length. There is a small market for them in Chinatown and some other areas. Some of my own research focuses on jack smelt and top smelt where I'm looking at the larval stages of these particular fish species. Although I do not come to study them in their habitat in Tomales Bay, I do come to Tomales Bay to collect these fish to take them back and spawn them and do work in the laboratory on them. The work we're doing with them includes a whole variety of areas, everything from how they grow under different feeding regimes to their biochemical composition as they grow.

Other work with these fish focuses on using their larvae as a way to assess toxic marine pollutants. A lot of industries discharge things into the ocean and no-one really knows how toxic they are to very sensitive life stages of different fish species. So we are developing toxicity tests, using the larvae of the jack smelt and top smelt as very, very sensitive indicators that the regulatory agencies can then use when regulating the toxicity arising from effluent discharges. There are only two other projects at the Bodega Marine Lab right now, that are going on in Tomales Bay, concerning fish species. Coincidentally, ironically rather, both of these projects are being conducted by graduate students who are not members of the U.C. Davis or the Lab but they are people who have come from all across the country to study Tomales Bay fishes.

One student for example is Richard Grankly, a graduate student from Cornell University in New York. He comes up here to study the toad fish, the singing toad fish that I'm sure most of you have heard about. If you live in a houseboat I'm sure you've heard them. Richard comes out here to work on the larval and the juvenile stages of the fish, trying to figure out how their hormones control the maturation of the fish and then how the hormonal makeup of the fish also helps stimulate it to go into the reproductive breeding stage. I'm not sure what the immediate applied aspect of this research might be because there is really no way to turn off their singing behavior when they go into the reproductive mode. In any case it still is a very interesting developmental or ichthyological question.

The other project deals with the dwarf surf perch. Let me see if I can find that. That's in the upper left hand corner. A graduate student from the University of California in Santa Barbara is working on the evolutionary life strategy, in the dwarf surf perch. You'll see him up here with the beach seine once every month or so, collecting the dwarf surf perch, to look at how often they reproduce, how many young are being produced per female, and how these different factors can affect the evolution of the fish over a time period.

That's about all I have to say about Tomales Bay Fisheries. I thought I'd show you one fish that was taken slightly offshore from here to let you know that some fairly big fish do occur in the area. This is an ocean sun fish that we collected in a purse seine. This particular beast was nine feet high by eight-and-a-half feet long. We have *no* idea what it weighed. We were able to get it over the side of the boat fairly easily and it swam away in perfectly good health but this gives you an indication that there is a lot more here besides small larval fish, herring, and so on.

I'd like to spend the rest of my time here answering questions, or if you can tell me some stories about the fish in Tomales Bay, I would very much like to listen. Thank you. (applause)



**Q.** What types of gear are being used to collect the different fishes here, what are the types of commercial fisheries and what effect that might these have on the ecosystem as a whole?

**A.** **Most** of the herring are being taken now with gill nets. You've all heard many horror stories about gill nets, offshore, entrapping seals, seabirds and so on. Those offshore nets are generally fairly large nets and it would be easy for an animal to get trapped in them. The herring fisheries here use very small mesh gill nets. I'm talking about mesh size which is two inches measured on the stretch diagonal, (e.g. it's a square mesh and they stretch it out and they measure how far they can stretch it apart). That's a fairly small mesh and it's very selective for the herring or fish of that size range. To the best of my knowledge it has not really been implicated in trapping any marine animals or seabirds. And if any of the Fish and Game biologists have any other information, I'd like to hear about that. In other areas they would use a purse seine to collect herring, but Tomales Bay is just too shallow a body of water. A purse seine is just a big net that two boats will stretch in a big circle. They generally use a main boat and then a skiff, and then they pull up a drawstring in the bottom of the net, thus encapsulating all of the fish in a single bag. And then they can pull the bag on board.

One of the boats we chartered is a purse seiner and she collected, in a single stretch of the purse seine, enough herring to take 27 hours to pump out the net and it's worth over 1.4 million dollars. Not too bad for setting a net in about 25 minutes. At the fishery up in British Columbia where this happened, the annual season is open for 15 minutes. It's either hit or miss.

As to the other types of fisheries here in Tomales Bay, I believe they use gill nets for shark. Maybe Tom could provide us some more information. (Tom concurs) I don't know if the gill nets have been implicated in any other problems with marine mammals species or bird species in this area.

**Tom Moore (Biologist at Department of Fish and Game)** I think we have almost 100% coverage this year on that. We've caught no mammals. Also no salmon.

**Dr. Shenker:** The other fishes, e.g., surf perch and jack smelt are generally caught with beach seines. They pile a seine net that might be 400 or 500 feet long, onto a boat, anchor one end to shore, then go in a big semi-circle. Then they pull on both end of the net. That's a fairly non-selective mode and will take everything that is out there. But they generally filter in a very small area of water and many of the fish that they do not take are just released.

**Q.** Is it true that the only value in the herring is the roe and the fertilizer?

**A.** That's pretty much it. There is a small market for pickled herring, kippered herring and so on, although I understand that the Atlantic Coast herring are more valued than the Pacific Coast herring. The Atlantic herring have a slightly higher fat content and I guess it tastes a little bit better. But, for the fisheries that we see here, it is primarily for the roe. It seems like a waste of a resource.

**A** It depends on what they do with the rest of the body. If they at least put it to some good use, it's not a total waste.

**Q.** Do you know anything about the parasite living in the herring.

**A.** Which parasite are you talking about?

**Q.** Well there is one living in the flesh, a little worm.

**A.** A white nematode worm, OK. Nematode worms are very common in most fish species. If you have sushi and your sushi has not been frozen for about 24 hours before you eat it, it might not be uncommon to see a little white worm wiggling in your sushi. So, this is a warning to make sure your fresh fish is frozen solid for about 2 days before you eat it. The nematode parasite, unless it's really abundant, is not going to be a serious problem to the fish, but most fish will have at least a few parasites in them.

**Q.** Do ichthyologists eat sushi?

**A.** You want a one-word answer? No; at least I don't.

**Q.** Could you address the myth versus the reality of the 'great white shark in Tomales Bay?

**A.** I would if I knew the difference between myth and reality and the great white shark. There have been several cases of very small, new-born great white shark, and by small, new-born I am talking about 4-5 foot in size, being caught near the mouth of Tomales Bay. There have been similar small shark taken up by Humboldt Bay, I believe, and down in Southern California. People have developed the idea that Tomales Bay is the breeding area for great whites. I don't know. I'd love to be able to find out the answer but I think they might just drop their young all up and down the Coast.

**Q.** A number of years ago they were harvesting eel grass. Are they still doing that, and what effect would that have on the fisheries?

**A.** To the best of my knowledge, they are not harvesting eel grass. Does anyone know of anyone currently doing that?

**Member of Audience** No, they're not doing that currently on Tomales Bay.

**A.** A big delicacy in Japan right now is getting the herring eggs after they have been spawned naturally on the kelp, and one of the things they're trying to do is to develop rafts where they can dangle kelp blades in the middle of a spawning school so the herring will come up and deposit their eggs right on the kelp. And then they just simply take the kelp strands and market them. And that's actually a very useful way of maximizing the use of a fish to come back and spawn next year and next year and the year after that.

**Q.** There's two species that you didn't mention, that's 'the striped bass and also the white sturgeon.



A. OK, the white sturgeon, from what I understand, used to spawn in Lagunitas Creek. I believe that the area has been dammed which has blocked the spawning ground of the sturgeon, but I am not sure. I am not an expert on the sturgeon. I have heard stories about sturgeon being found accumulating in schools at the bottom of the darns and I don't know what would be required to try to re-establish a sturgeon run here in the Bay. I don't believe they are being caught commercially or much even by sports fisherman.

Striped bass are one of the introduced species that Dr. Hedgepeth mentioned earlier. It was introduced here about 80 or 100 years ago and has adapted beautifully. It loves this part of the West Coast, as do most of us. Striped bass typically spawn up in fresh water rivers where they have about a two-week drift before the larvae will make it into a salt water environment. So there's not much spawning of striped bass going on in this immediate region at this time that I know about. There is more going on, of course, in the San Francisco Bay Delta region. There have been stories about the striped bass spawning up in the Estero Americano about 20 or 30 or 40 years ago, but that has not been verified so I do not know whether that's true or not. Well, thank you. (Applause)

**Carl Munger** (Moderator): Jules Evens, the next speaker, has been a resident of this area for about 17 years and he has worked for the Point Reyes Bird Observatory for about fifteen and a half of those years. His major emphasis of study and work is on estuarine bird populations and he's done a lot of work with endangered species, the rail and the osprey. Probably most important to his life right now is that in November, a week from now, his book, *The Natural History of the Point Reyes Peninsula*, is being published.

## **Waterbirds of Tomales Bay**

Jules Evens, Wetland-, biologist

Thank you. My voice is a little hoarse since I've been at a soccer game so if lose it in the middle, you'll know why. It will be from cheering for the eight-year-olds. The Inverness team won, by the way.

There are over 100 species of water birds that can be found along these shores in any year, many in impressive numbers. This diversity makes it difficult to address the subject in 15 minutes. In mid-winter, when the herring that we have been talking about are spawning in the eel grass beds around Hog Island, there are up to tens of thousands of diving ducks in the Bay, mostly scaup, surf scooters, which you saw earlier eating the baby mussels, and buffalo head. There are thousands of loons and grebes. That's an arctic loon in the picture. There are grebes, cormorants, gulls and dabbling ducks. Pintailed wigeons stream into the Bay, perhaps cued to the activity of the ever-vigilant gulls that are flashing their white wings at the other birds and signalling that there are herring present.

In spring and fall, equally impressive numbers of waders congregate on the tidal flats, refuelling during their long-distance migration. Many of these species spend the winter here. Particularly abundant during the winters are numbers of small sandpipers like the dunlin and sanderling and least and western sandpipers, and several larger species likes willets and godwits.

The willet is probably the most common year-round wader we have on these shores. Some areas of particular importance to these waders are the tidal flats near the mouth of the Bay at Lawson's Landing and near the south end off Willow Point. Most of the congregations, especially at high tide, are in those two spots, although of course the whole shoreline is of value to them.

This is the long-billed godwit that gathers in huge flocks by Lawson's Landing. Also you see a long-billed curlew and a willet representing the shore birds. In the summer there are brown pelicans and white pelicans, cormorants and osprey, perhaps several terns and a smattering of other species that are distributed throughout the Bay.

So the point of all this is that varying species use the Bay at varying times of the year. Winter is the season of peak abundance here in Tomales Bay and most of the Bay Area.

For the remainder of my time, I am going to focus on four select species that I feel are representative of different habitat types and whose natural histories are illustrative of some of the changes that have ensued over the last 100 or so years. Mostly I am going to speak extemporaneously but I am also going to use some excerpts from my book in the interests of saving time.

When we are thinking about Tomales Bay, I think it is important to consider the entire Bay, which means the upland as well as the Bay itself. So I am going to start with the riparian areas of the streamside thickets that border the Bay and move out to the open water. Riparian habitat, like this along Papermill Creek (or Lagunitas Creek) harbors several species which I will show in a few minutes. The area provides cover, a migration corridor, and a nesting habitat for both water birds and land birds. I think it's one of the primary issues that gets overlooked a lot when we are thinking about bays and estuaries in particular. Besides providing habitat for the birds, it's a natural buffer from the uplands from roads and human activity.

Black crowned night herons occur around Tomales Bay and roost in the riparian habitat and then they will move out to the mud flats to eat crabs or whatever invertebrates they're after, usually at dusk. You can hear them barking as they fly over. That's one hunting at the edge of Tomales

Bay. Green herons use the willows that, overhang Lagunitas Creek as cover. They are very secretive. This is an unusual picture of one that happened to be out in the open. That's because it was taken in Florida and not in California.

Red-shouldered hawks are quite common around here compared to the rest of California and they use the riparian cover as well. You'll often see them on the phone lines as you go from here to Point Reyes. Wood ducks also hide under the overhanging willows in Papermill Creek and are actually increasing in recent years. They are again, like the green heron, very secretive and seldom seen.

The riparian habitat is particularly important to migrant birds that are either breeding here or passing through on their way to the neo-Tropics. Most of these birds are insect eaters and they glean the willows and alders. This happens to be a type of yellow green vireo. Tansin's warblers are quite common in the riparian habitat during migration. Wilson's warblers breed here in large numbers and mostly in the willow riparian habitat. The yellow warbler is another species that breeds down in the Olema Marsh but is a threatened species likely to be endangered in the near future. I'll explain why in a few minutes.

A representative species I chose was the common yellowthroat which breeds along the shoreline of Tomales Bay up to Olema Marsh. Again, it's a warbler, an insect eater. It doesn't happen to migrate to the neo-tropics, or our population doesn't. It can stay here all year long. Their population has been decreasing, although 'not so dramatically as some others, in recent years. We've been monitoring the population at Olema Marsh which has one of the highest concentrations in coastal California.

One of the problems with this species, as with a lot of the others, is that as you reduce the cover, that as you cut down the willows because of grazing or road work, or whatever, it opens them up to predation from cowbirds. Cowbirds come and lay their eggs in their nests. The young cowbirds out-compete the warblers for food from the adults. The adult is so pumped up with testosterone, or whatever, to feed the young that it doesn't discriminate between the cowbird and its own children. It feeds the most aggressive. The numbers of cowbirds have been increasing in California with additional feedlots which allow their populations to sustain themselves through the winter.

This is typical yellowthroat habitat. - This happens to be at Shields Marsh which is a protected habitat down near the Inverness Motel. They like those areas where freshwater marsh integrates with salt marsh and is overhung by riparian areas.

In moving down into the salt marsh, (this happens to be at Bolinas Lagoon), we have another species that I have been particularly interested in over the last several years, which is the black rail. We have been studying them in San Francisco Bay and Tomales Bay. They are basically extinct in most of California except in those two spots. The San Francisco Bay has by far the largest population and there is a small population in what remains of the salt marsh at the south end of Tomales Bay. They are very secretive and they hang out in the pickleweed, the salt marsh vegetation.

One way to get a chance to see them is to go out at extreme high tides during the winter. When I was doing that several years ago, we noticed that the tide would come up and drive them into the upper edge of the salt marsh, for instance in this area which is probably *Grindelia* or tar weed. And then, on extremely high tides, after rain or during the flood, they are forced out of the salt marsh because the water gets too high and they have to fly across open water, often, especially in areas where levies have been dredged around the edge of the marsh. At those points, there were egrets and herons waiting there to eat them.

We started watching them systematically and found many more black rails than we even knew occurred in the marsh suffering predation by egrets and herons, especially great egrets and great blue herons. I thought that was interesting in that we had spent a lot of energy making it possible for egrets and herons to breed, which is wonderful, but at the same time, it is having effects beyond what we realized.

Also, in that habitat, by the way, are several other species of rail. I just threw these pictures in so that you would know these guys existed because you never see them. This is a Virginia rail, which winters particularly around the edge of Tomales Bay and a soarer rail. All the rails are suffering declining populations because of loss of wetlands all over the country because of drainage, rising sea levels, etc.

This brings us to species of the open water. This happens to be the Bolinas Lagoon. This is the black brant. I am going to read an excerpt from my book that is coming out because it's easier than talking extemporaneously. Black brants fly into Tomales Bay, especially in April when you'll see large flocks of them, when there are onshore winds and they are migrating south from Alaska. They're blown onshore and they come and feed on the eel grass beds that we have been talking about. In former days many thousand black brant wintered on Tomales Bay and Drake's Estero. From 1931 to 1932 the Point Reyes population averaged about 8,000 brant. Since the mid-1950s the winter population has decreased and never exceeds about 450 birds although hundreds are still pause during spring migration. In the mid-1960s the entire population shifted its wintering grounds from the Pacific states to the Gulf of California. The shift may be attributable to depletion of the eel grass beds (a primary food source), a change in feeding habits, human disturbance, or some combination of the three. Whatever the cause of the decline, the bays are less vital in the absence of this magnificent "sea goose." Incidentally, if any of the speakers know whether there has been any systematic study of the decrease or increase in the eel grass, I'd like to hear about, it afterwards.

Another species which represents open water to me and has perhaps the most interesting history of the ones we've talked about so far is the osprey. Here is a nest out on Tomales Bay on top of one of the old duck blinds that's been active for several years. It's below the Giacomini's house up on the ridge. You can pull out on the road and look right down into the nest and see the young. Many of you are probably familiar with the osprey which nest up on Inverness Ridge. I'll read you a brief history of this species because I think it ends on a positive note. It's a species that has been increasing rather than decreasing, at least in recent years.

"Although osprey are now-fairly common, there is scant evidence available on their nesting status in this area prior to the 1970s. This dearth of information probably reflects an absence of birds. One 1933 text, *Birds of Marin County*, lists osprey as "very rare"; another, from 1944, makes no mention of breeding records in Marin.

"During the first half of the century (and probably earlier) osprey suffered declines throughout its range due to persecution by man and environmental poisoning. In the early 1960s, researchers noticed the decline of a breeding colony of osprey along the Connecticut River and implicated agricultural pesticides as a cause". Reproductive success decreased, by the way, primarily due to eggshell thinning.

"After 1972, when DDT was banned, ospreys began to show signs of increasing in areas where their numbers had previously declined. During the 1960s and 1970s, another phenomenon was boosting the osprey population, especially in the western states. With agricultural and urban development in the and West came an increasing need for the impoundment of water. The

construction of dams and reservoirs provided habitat that ospreys proved capable of colonizing. Which brings us to Point Reyes."

"On the north slope of Mount Tamalpais, the construction of Peters Dam in 1954 flooded the narrow canyons of Lagunitas and Big Carson Creeks, creating a large reservoir (Kent Lake) where redwood and silver salmon used to reign. An extensive fire in 1945 had severely pruned, or even killed, many of the redwoods and the bases of many others were drowned with the rising level of the reservoir. As a result there are numerous "snags" that the osprey have appropriated as nesting sites. The availability of nesting sites is not the only quality that makes Kent Lake so attractive to the osprey. In the absence of public roads, the area is relatively remote and free of human disturbance. The water is clear and well stocked with fish, providing a ready food source, particularly for recently fledged individuals, and it is relatively close to the coast of Bolinas Lagoon and Tomales Bay, well within the foraging flight of an osprey."

"Ospreys probably colonized Kent Lake in the late 1960s (the first known nest I could find out about was in 1967); by 1980 there were 11 active nests, and by 1986 there were 24 active nests". (Since this has been written, this year there were 28 active nests, which is about the same as last year. It is possible that they have stabilized.) "We do not know when they began to nest on Inverness Ridge, but there has been a marked increase since the late 1970s. By 1987, 12 nest sites were located on Inverness Ridge. It seems likely that as the Kent Lake population increased, it "spilled over" to Tomales Bay, and that the two populations are related."

"Today, when we see an osprey circling over Mount Vision or Tomales Bay, we realize that its gyre encompasses our shared history and our shared destiny. Two decades ago low reproductive success in ospreys alerted us to the otherwise invisible threats of organo-chlorine contamination. In the decades to come, a decline in the local osprey population could flag the destructive effects of acid rain or some other as yet unidentified environmental threat. For now, we watch these birds with an appreciative eye, knowing that their presence here is as transitory as our own."

It is interesting how our perspectives change over time. For me, ospreys are so representative of Tomales Bay because their presence is so obvious and everybody sees them every day, especially in the summer. But, to close, I just want to read one quote about the osprey that was written in the 1930s by an ornithologist, but it shows how our perspectives about certain things change or, as things get rarer, we become more appreciative of them.

This is William Dawson who wrote *The Birds of California*..

"Whether or not fish is proper brain food depends more upon the brain than it does upon the fish. An exclusive diet of fish has not made the fish hawks either brainy or valiant. We need not be troubled on the latter score, though, for in a family, [birds of prey] where prowess and tyranny are almost synonymous, it is a comfort to find birds who mind their own business and exhibit a proper humility."

**Q.** About 25 or 30 years ago, the kite was endangered. I think I have seen some more of them lately. Can you say anything more about how they are doing?

**A.** Yes. The kites are doing quite well in recent years. They only eat one species of rodent, essentially, a little *Microtus*, a field vole, and they seem to be doing all right. Voles are nomadic, and some years we have tremendous numbers around here because voles, like lemmings, are

sporadic in their occurrence. When there is a good vole year, usually after a couple of rainy years, there are a lot of kites around.

I think that in 1979 there were 20 to 30 pairs nesting in the Olema Valley. Now there are 2 or 3. Every year there are a couple but in some years there are large numbers. They are doing pretty well. They are not listed, they are one of those species that people watch because they are good indicator species. But right now their populations are actually expanding. They just started breeding in Oregon a couple of years ago. They are moving north.

**Q.** What kind of use is made of the Estero Americano by birds as their habitat?

**A.** I don't know of any systematic surveys of the area, but it is probably comparable to Tomales Bay or any of the coastal estuaries.

**Comment from audience** Dr. Peter\_\_\_\_\_ from the Bodega Marine Lab is just beginning a survey of the bird life in the Estero right now.

**Q.** Are there peregrines here?

**A.** The population around here was introduced and they are monitored closely. They seem to be doing all right.

**Q.** Do wood ducks breed here, Jules?

**A.** In very small numbers, yes.

**Q.** When we were up in Oregon fishing, I noticed that they had posted a lot of wood duck houses high up in the trees. Could you do that here?

**A.** There are wood duck houses here, mostly on Marin Municipal Water District land. You could do it here. Wood duck houses are usually put in willows or alders over water, so when f-he young tumble out, they fall into the water. They are more apt to be successful over water than over land.

**Q.** We used to watch the ospreys a lot and we spent lots and lots of time watching them fish. Very infrequently did we see them actually catch anything and then, they often drop it on the way back off home. I often wonder how they survive.

**A.** Actually, as predators go, osprey are one of the more successful. Studies have found that they have a really high success rate, something like 70%. Most raptors are down around 10% to 20%. You might be seeing young that are just learning to fly but adults generally are quite good at it. I've never seen them drop a fish. Maybe that was just a certain pair that were clumsy.

**Q.** They'll sometimes get a fish that's too big for them.

A. Oh really. I've heard rumors of birds actually drowning. Catching salmon that they wouldn't let go of, and drowning.

Q. You hear that people see bald eagles occasionally on the Bay. Do you know if that is so?

A. Yes, bald eagles are stragglers here. Usually the ones we find are young birds, one, two or three-year-olds who aren't breeding yet. I haven't seen any for a few years. Usually they show up around November and on rare occasions will stay and eat crippled ducks and coots. A couple stayed on the Bolinas Lagoon about 5 years ago. But in general, they are very rare. There were some thoughts about introducing some into this area. I don't know the status of that right now.

Q. Jules, could you tell me something about the status of black rails as a species in California.

A. The black rail that we talked about earlier, the salt marsh breeder, is being considered for endangered status right now. 95% of its habitat has been lost in the last 100 years, especially in San Francisco Bay and all of Southern California, through filling of tidal wetlands. We're at the point at the Bird Observatory where we have just completed a year-long survey of all of San Francisco Bay to determine its abundance and distribution. We've found that it's much more patchily distributed than we thought. That is, they only occur in small island-like areas that are high enough that they are not inundated by every tide. It's likely that the State will petition the Federal Government to elevate their status from threatened, which it is now, to endangered.

If that happens, I don't know what the legal implications will be. It will be a long process. Wetlands are supposedly protected as it is, but there are so many variables affecting them now, especially, I think, the rising sea levels. Thank you. (Applause)

## **PART IV**

Don Neubacher, Point Reyes National Seashore,  
Moderator

One thing many people don't realize is that a large percentage of Tomales Bay on the West side is administered by the Seashore. Some of the East side is within the boundaries of Golden Gate National Recreation Area, and then most of the Bay is within the Marine Sanctuary. And then the fisheries are administered by the Department of Fish and Game. This is a complex system to organize. Maybe it's a polite thing to say that we are really not doing that great of a job administering the whole system, because we need to focus on it more.

Now we are learning a little bit more about the Bay, what do we do next? What is the next big step for us as citizens? We live in a spot that is so beautiful, but then we realize the following: we've got future oyster development; we have a new conference site; we have a sewage system that's going to take place; we have mussel harvesting; we have more boats on the Bay; we have 2.2 million people per annum now coming to the National Seashore.

You say to yourself, "Gosh, where does it stop? Can we really protect this Bay." It's important for me, having been here for about eight years, to really focus on that for a while. I think the next two to three, or maybe five years, are going to be crucial.

One of the reasons we came up with this idea for the State of the Bay Conference was to start that process. We've brought in a lot of distinguished minds. It is, I think, a critical time for this pristine estuary. Hopefully during our next session we can focus on what should be our next step.

I have the honor of introducing Michael Josselyn, who was also part of the process initially. We went to him and we said, "How can we start looking at the Bay? Is the State of the Bay Conference a good idea?" He said, "Yes." Michael is the Director of the Tiburon Center for Environmental Studies. He has done a lot of work on the Bay and he's from San Francisco State University. Hopefully, this next session will lead us in the right direction. Thanks, Michael.



**PART IV(A)**  
**PROBLEMS FACING TOMALES BAY**  
Dr. Michael Josselyn, Director  
Tiburon Center for Environmental Studies  
(Written Text)

Tomales Bay is the "jewel" along the beautiful coastline of Marin County. We have heard today about its fisheries, its ecology, and its problems. The scientists and speakers gathered here today have provided us with much to think about. Some of their conclusions may have confirmed what many of us have suspected for a long time, other ideas may be surprises or contrary to commonly held concepts about the Bay. Such research serves as the necessary precursor to developing sound management programs for the Bay. yet, it can be a risky undertaking. We may find out things aren't what we expected, maybe they aren't as bad as we think, or perhaps the problems are much more profound than suspected.

It is easy to apply the term "pristine" to Tomales Bay. Certainly, compared to San Francisco Bay, most would agree that Tomales Bay is much cleaner, less developed, and more natural. Yet, I have heard people from New York, Europe and many other populated regions exclaim that San Francisco Bay is pristine and natural, wondering why we are so concerned about its health. After all, it has blue water, green marshes, seals, sea lions, and even whales.

However, no estuarine system in California is pristine. All, from Mission Bay in the south to Humboldt Bay in the north, have been altered significantly. The most common alteration has been sedimentation due to historically poor agricultural practices. Many have been filled in by a third or more. While marshes may have expanded, open water and mudflats have been decreased. The second most common alteration has been freshwater inflow alteration, primarily impoundment and diversion of freshwater inflow. This has had particularly severe impacts on anadromous fisheries. Finally, shoreline development and its concomitant effect on habitat loss and water quality degradation is a major alteration felt by most coastal estuaries.

Tomales Bay has suffered all these alterations, yet to our current generation it appears pristine. But many of you have sensed the threat, the possibility that the Bay may not remain as the jewel it currently is. Questions as to the ability of the Bay to support the aquaculture industry, the impact of freshwater diversion and dams on anadromous fish, the status of habitat quality to sustain fish and wildlife resources are being asked. In addition, threats from the urbanized region of the County continue. Because the ability of San Francisco Bay to absorb more pollutant discharges is now far exceeded, other discharge locations in less populated areas are being considered. West Marin may not be faced with the once proposed housing developments of the '60's and '70's, but you are faced with the products of that development to the north and east.

The citizens of West Marin have long been aware of these problems and have attempted to resolve them in a piecemeal fashion as necessary. Certainly, one can't deny the high level of awareness about erosion control and the funding provided by the Coastal Conservancy to install erosion control facilities. However, what has been missing is the ability to take a holistic management approach to all the Bay's problems, the primary reason being the lack of scientific information about the Bay. Yes, there is plenty of data, but it was not collected with a mind to develop a comprehensive picture of how the Bay functions as a whole.

In 1985, a proposal was developed to resolve that problem. The proposal was developed by a number of institutions, including, the Romberg Tiburon Centers, Bodega Bay Marine Laboratory, Point Reyes Bird Observatory, and the US Geological Survey. It received significant community

support. The proposal was submitted to the San Francisco Foundation and requested a little over \$1 million dollars for three years. It was a comprehensive approach; expensive, yes; but compared to the economic value of the estuary, a relatively small expenditure that would benefit the Bay for years to come.

In my experience in submitting proposals, I have learned-that three things are. necessary: the right idea, the right place, and the right time. We only had two of the three. Soon after our submittal, the San Francisco Foundation ceased operation of the Buck Trust and it was transferred to the Marin Community Foundation. We attempted to get major funding again within the major projects category with the proposed establishment of the National Center on Urban Estuaries. That attempt failed as well.

Research is now being conducted on the Bay, but at a much smaller level than necessary to accomplish the goals we all wish. We need to develop a coordinated approach to management of the Bay. What do we want from Tomales Bay? There are many overlapping jurisdictions, many competing interests. Obviously, we won't all get what we desire and we may find that commonly held conceptions of the Bay may not be true. But, it is clear that so much public interest, so much public concern, cannot be stopped by the forces who think the status quo is acceptable.

I recommend that we initiate a Tomales Bay Interagency Task Force, modeled after 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, through the participating organizations, focus the funding necessary to accomplish those goals and needs. Such a Task Force can be operated at the County level, perhaps in the planning department.

Second, I strongly urge all of you to continue your efforts to see that Tomales Bay receives the attention it deserves and is not simply viewed as a neglected resource because so many other problems may appear to be more important. I hope there will be many more annual State of the Bay meetings and that next year we have much more progress to report.

## Part IVB

### Panel Discussion

Michael Josselyn (Moderator)

This is an important part of the program because we do want to get your input as well as talk a little bit about the kinds of things we see for the future of Tomales Bay.

Recently scientists have been sometimes stated to be those busy beavers who are coming up with yet another world disaster, like "acid rain", or "holes in the ozone layer". We talk about "global warming" as a trend for perhaps the most disastrous types of conditions that could occur with sea levels rising, and temperature changes and droughts which will occur throughout the world. But we should say, "Well, maybe it's global warming. We shouldn't try to make it into a disaster."

But there are government leaders who distrust scientists. In fact, Proxmire stated at one point that after listening to a long litany of scientific evidence, "I wish we just had one-armed scientists, those scientists who would not go on for 5 or 10 minutes and then go on to say, 'Well, on the other hand, the results can be stated in a different sort of way.'" So there is a tendency, some times, to distrust scientists and the results that they yield.

We really don't know the answers to many of the questions that people have asked today: How many oysters should be in the Bay? What is the best fishery production? Are we at a maximum or a minimum in fishery production? Do we have suitable habitat for the number of species of migratory birds here in the Bay? What are the effects of sedimentation or the effects of freshwater withdrawal from the Bay? We don't have answers to those types of questions.

You might say, well scientists are simply going to say we need more research and it will simply lead to further questions. Recently, in fact, there was a review of the research program that had been conducted in San Francisco Bay for the past 10 years. The State Department of Fish and Game and the federal agencies involved in studying the impact of freshwater inflow to San Francisco Bay invited a panel of experts from around the country to come and review the program, a program which for 10 years has spent a little over 20 million dollars studying San Francisco Bay. And they said, "Well, we really don't know that much about the Bay. We can't answer the questions about freshwater inflow and how much is necessary to protect it.

The scientists answered that no-one really started at the beginning with a conceptual approach about how to study the Bay. What types of organisms to focus on? What types of processes to focus on? So we need to develop what is called a "holistic" approach, an approach that looks at a system as a whole and breaks it down eventually into smaller parts, but coordinates a number of studies.

In a plan that was developed for an estuary in Rhode Island, this holistic approach was described in this way: "The holistic ecosystem-based approach to management, although it has the most potential for enabling a manager to make good decisions for long-term benefit of society, is painful and politically risky to practice." And, indeed, this is probably the most important point. If we are going into a study, there will be a number of things which people will be surprised to find out about, both good and bad. And many people aren't willing to make that change or take that risk.

I would like to note that Dr. Smith and Dr. Hollibaugh have initiated a program called Biochemical Research In Estuaries. If you look at that acronym, that spells BRIE, which is quite appropriate for the western part of Marin County. This study is designed to look at an estuary as a whole, the chemistry of an estuary and its circulation patterns, and how the circulation patterns affect that chemical budget.

So we have a beginning, but we have a long way to go. We have a number of programs that are represented by the scientists here on the Panel. I would like them, starting with Steve Smith, perhaps to say a few words about their research, and then also to open it up to the audience for questions.

**Dr. Smith:** Yes. Thanks, Mike. A good deal of the discussion that I've already given today is of course related to our project so I am not going to give a repeat of that. The basic reason for that particular investigation is perhaps worth pushing a little bit. I mentioned that we are doing work on nitrogen and phosphorus. You probably have all heard of the process of eutrophication. Cultural eutrophication is, of course, when you are getting the addition of fertilizer nutrients because of man's activities. One of the problems that we are faced with is that so many places now have felt this sort of eutrophication over the years, it is sometimes hard to find places that are good to study under more or less natural circumstances.

Another point here is that it's very difficult to study such processes in very complicated estuaries, whether they are natural or disturbed, because the complexity simply makes the questions that are being asked hard to sort out. It's hard to see the forest for the trees. Tomales Bay has proven to be ideal for our work, but one of our real limitations that we face over the years is that of getting a long-term data base.

Many of the questions that I have heard today posed to the speakers, myself included, have really related to the ability to establish data over a number of years: to find out what sorts of inter-annual variations there are, to figure out what varies with what, in order to find out what the controls are. So our hope is that over the next several years to be able to get continued funding in order to be able to follow eutrophication in this system long enough to start understanding some of these very basic questions on the one hand, (going to Senator Proxmire's remarks that my colleague just alluded to), and, on the other hand, to have a better understanding as to how these things can be controlled when they do become problems.

Now, from my own vantage, and I am sure from Tim Hollibaugh's as well, the certain things that we are looking for is community support. It makes it easier for us to go to funding agencies, such as the National Science Foundation, or the National Marine Sanctuaries Program, or programs of this sort, to say that the community is behind what we are doing. We are not advocates for any position in terms of thinking that Plan A is right in a management sense versus Plan B versus Plan C. But our data is useful in the vast scope of the economy. What we do doesn't really cost very much. And the thing that makes it easiest for us to be able to do that is for you, in some sort of concerted effort, to tell our funding agencies that what we are doing is worth while. Thanks.

**Dr. Shenker:** I'm interested in microbiological processes in the Bay and the relationship between microbiological processes and these nutrient cycle questions in Tomales Bay.

I think I've told you a little bit- about some of my work in dealing with the early life stages of marine -fishes. Particularly in the use of the tool for monitoring the toxicity of marine effluents. That's one of the things I'm continuing to pursue in a variety of areas to try to identify the sources

of marine pollutants and try to help industry actually figure out where in their industrial process these pollutants are arising. From this, they can then focus their waste treatment technology in the most cost effective manner. Hopefully, by working together with the industrial people, we can end up with a workable solution that is not going to close a mill down. And this is some of the work we have been doing up along the Northern California coast.

In terms of work here in Tomales Bay, I am just collecting specimens from Tomales Bay at the moment. I would dearly love an opportunity to work on a holistic approach to the spawning in Tomales Bay and how do larval fish in Tomales Bay interact with the current circulation patterns to determine how they end up in a nursery zone and how that affects their ultimate survival and growth and recruitment into the adult population. I was involved earlier in the development of the major proposal to the San Francisco Foundation which unfortunately has fallen apart. We are very much looking forward to an opportunity to continue on with that type of research.

I should mention one other thing that is of concern to all of us here today. That is the waste water disposal proposal that is going on. I am currently starting up a project right to look at the circulation patterns in Bodega Bay itself trying to pull together all the available data on oceanographic circulation in Bodega Bay that has been developed over the last 20 years or longer. And that's a fairly good body of data. P.G.& E. tried to put a power plant out there. And so there's been a fair amount of oceanographic monitoring. So I am trying to put all of this information together to try to determine where the water leaving the mouth of the Estero Americano is going to go. How frequently does it go south? How frequently does it go north? How much of it is dispersed? And this will be a first step in trying to determine the extent of the danger to which Tomales Bay might be exposed to water coming down from the mouth of the Estero Americano.

When we have assembled this data base, we will then be able to make predictions as to how much water does come down this way. Or, if we are not able to make a firm prediction, point out exactly what types of steps are needed to develop such a data base.

**Q.** Has there been any research done in regard to the effects of acid rain or acid fog in the area?

**Dr. Shenker:** In this particular area, I am unaware of such. Does anyone know? Acid rain can be more of a problem in the North East part of the United States than along this vast Western periphery. That's mainly a function of the circulation of the smoke plumes from the power generating stations. Most of them blow in that direction. So, unless there's a power plant down wind from us, we are not going to be affected too severely.

**Comment from the Audience** I think Armin Rosencranz is someone who has done some work on acid fog in this area. I don't believe he's here today.

**J. Evens:** Well, through the Point Reyes Bird Observatory I have been involved in a lot of work on estuarine birds, which I alluded to in the talk I gave earlier. I'll try to give you an idea of what we do, although it's not always easy to explain. Perhaps the thing that applies most directly to Tomales Bay is our census of the bird population which we have- been doing for about 16 years so as to develop some kind of baseline so we can recognize variations in populations when they occur.

Recently we were asked to assess the impact of the oil spill that occurred in April, 1988 in the San Francisco Bay on two species of rails, particularly, as well as shore birds that occurred in the Bay. It is difficult to come in after some cataclysmic event and say what has happened if you don't know what was there beforehand. We had no idea of the size of the rail population in the salt

marshes there because nobody had ever funded research to find out. By chance, we began research when the oil spill happened, but it really didn't come until after the spill. So, now we have a lot of data on what's there after the spill but we don't know what was there before.

So, I think that the work on the coastal estuaries that I and a lot of other people have been involved in will be useful in the future for recognizing changes as they occur. Sarah Allen has done a lot of work monitoring the population size of harbor seals off the coast. This will be handy in the future when we start to learn something about how their populations change over time. I'd be glad to answer any specific questions anybody has later during dinner.

**G. Trevelyan:** I am finishing up my doctorate now, and I'm interested in how aquaculture and other interests in the Bay can co-exist and how water quality can be protected in Tomales Bay.

**J. Finger:** I don't think you can call what I do research. I am just trying to make a living right now. We do look at our work as a very environmentally sensitive business and a very environmentally sound business. Our way of life is at stake if the water quality or the general nature of this Bay changes so we're very very careful about what we do. Thank you.

**Dr. Josselyn:** I'd like to invite the audience to address questions to the panel and to bring up issues of importance that you feel have been missed both by the conference or by any of the panelists.

**Q.** This is a question directed to you. What has happened to the proposal for funding from the Buck Fund, since the Fund is still here and obviously it sounded like a very good idea at the time?

**Dr. Josselyn** Yes, at the moment, Steve and Tim have been involved in submitting to other organizations-the National Science Foundation currently supports their work-and Tim has a proposal in to Sea Grant. We do have a proposal to the Community Foundation starting next July, a request for about \$100,000 to support and augment, the funding of Tim here in Tomales Bay. So we could certainly use support letters for that proposal to the Community Foundation. But their total budget for the environment program has been cut substantially from what it was when it was operated by the San Francisco Foundation. The total budget for the environmental program is about \$1,000,000 a year and there are many other proposals that are going to be received by the Foundation for the environmental program. We're asking for about one-tenth of their budget for the Tomales Bay Study. So we'll need to show community support for that type of activity. But we don't expect that the Community Foundation will be in a position, as the San Francisco Foundation was, to support and be the major benefactor, if you will, of Tomales Bay studies.

**Q** We've heard a great deal about the need for research studies but I think I'd like to see the item discussed a little bit by you people as to how the decisions will be made on Tomales Bay and, won't they be political and social decisions? That's my key question. We all recognize that we have to collect facts through research. But that is the supporting element of how other decisions are made. And I'd like to hear a little discussion from you as to how you expect to transfer the knowledge that is gained through the research to the actual process of getting changes made. Long-term research won't do it. It's beneficial and should be going on. But it will be a little bit too late, I think most of us would agree, when that comes around. So, short-term applied research is what we need, and more importantly, I think you need to collate together the information that's currently

known about Tomales Bay. There's quite a lot of information here that could be currently used for making some of these political social decisions. Any discussion on that?

**Dr. Josselyn** That's a very good point. In our proposal we did look at the past data. Certainly there has been a lot of information collected. It's species-oriented. A lot of it deals with benthic organisms. When we developed the proposal, we were looking at the *management* approach. The primary issues that we addressed were: sedimentation, fresh water inflow, and water quality. So the research projects that were proposed under that overall scheme were directed towards those concepts to provide the answers to simple questions. Is the Bay filling up or, perhaps, has that filling rate slowed down?

Maybe there are just localized subjects that are of concern. For example, there are questions about the primary productivity. I think that Dr. Smith's work has already changed our opinions about how Tomales Bay really functions. Thus we might reach different management conclusions. So the approach was to bring this data together and also to address studies that would deal with those primary management issues.

I think you are absolutely right in regard to the political situation out here because there's- a concern that perhaps the status quo has served us well and let's just keep doing that, without taking into account the fact that the world is changing and this area is changing and we have to be prepared to manage for that. Anybody else?

**Dr. Hollibaugh** I'd like to respond to this question as well. The work that we're doing with circulation with funds from the National Science Foundation is not specifically aimed at preserving Tomales Bay and any of its resources per se. It -may have application in the long run because, circulation in the Bay, changes in water quality, primarily chemistry, temperature etc., are going to be very useful in addressing questions that concern impacts of changes on, say, the water or sewage going into the Bay.

A direct application of our research at the national level right now concerns Chesapeake Bay. There is a very large problem there with eutrophication. There is an ongoing, very bitter argument over what materials should be regulated as far as current control of the eutrophication in Chesapeake Bay. On the one hand people are saying that phosphorus is not important in eutrophication. There was a recent study that suggested that a lot of the nitrogen going into Chesapeake Bay was due to acid rain bringing nitrogen out of the atmosphere.

In freshwater systems, it has been demonstrated over time, that Phosphorus is the element causing eutrophication. So the questions that we are addressing here and the answers we are getting are suggesting that the phosphorus limitation theory appears to hold for marine systems as well. The direct present day implication of that has to do with treatment practices on Chesapeake Bay and whether or not expensive plants should be built to remove nitrogen from effluents, and whether that would be more cost effective than to try to control phosphorus going into Chesapeake Bay.

Now, true, that does not apply to Tomales Bay. But, at the national level and for other areas, it is very important work. The point I am making, I guess, is that some of the work that's being done and can be done here, while it may not bear directly right now on this Bay, may very well bear on other aspects of your life.

**Q.** I have a question. Is there a board or committee that is studying the whole Bay?

**Panelist:** No, there's not. Recently, Morro Bay, which has some of the very same problems--heavy sedimentation due to agricultural grazing practices, water quality problems due to lack of appropriate sewage treatment--has started an inter-agency task force that meets quarterly and is developing an overall plan.

**Q.** Could that come from this panel?

**Panelist:** It could come from some of the people on this panel as well as being joined by other agency people and other community people.

**Q** I would like to address that briefly. I have been on the Bolinas Lagoon Technical Advisory Committee which was an outgrowth of the very fact that there were something like twenty-seven agencies, located anywhere from Washington, D.C. down to the county level, down to the Bolinas Rod and Boat Club, that had some jurisdiction, some interest in the Bolinas Lagoon. And so the County Department of Parks and Recreations decided to get the community citizens together, the fishermen, the boaters, the Audubon Society, just people at large, and let them get together every three months, cast out any problems that were coming up, come together with scientists, the Army Corps of Engineers, whatever is being brought up, and use that as a kind of conduit to reasonably bring, everything together for eventual presentation to the Board of Supervisors.

And my feeling is that we are dealing with cultural and political decisions that have to ultimately be made. I think, for example, the oysters versus the right of way for navigation for yacht races is a wonderful example. So perhaps there might be a gestation process happening here in this room today along the lines of putting together an umbrella organization to put all the inputs together and solve these problems.

**Panelist:** I was struck today about the metaphor about the difference between the land use and the Bay use. When you think about land use, you have entities, such as national forest, a primitive forest, or 'a wilderness area. But I don't have a conceptual overriding notion of what the Bay is. Is it a wilderness area? Is it a primitive forest? Is it a national forest?

If it's a national forest, where the trade-off is multiple use, we might learn some lessons there. But somehow, if you have fifty interests in the forest, and the forest keeps trading off each time, that creates real problems.

So, maybe there's a whole new concept here of what the Bay is. Maybe there are distinctions, I don't know. But somehow it might give us a clear conceptual goal for whatever action you have, so that people are all talking about the same thing, rather than arguing.

**J. Evens:** There's an article in the new issue of *Bioscience* (which is a common journal easily available in the library) about bio-parks, and I think Tomales Bay may qualify for that concept, where you are stressing inter-relatedness of things and the broad ecosystem rather than individual species or recreational areas. If it were designated a bio-park it would therefore fall under one single legislative body, to regulate.

**Panelist:** There's a significant problem that's going to occur in about two weeks related to Tomales Bay because Tomales Bay has become, in effect, like Northern California in its relationship to Southern California and the Peripheral Canal. Tomales Bay used to be the watershed



for West Marin. It all came here. Now, instead of going by canal, the water is piped to the eastern part of the county where it is consumed.

I don't know how many people came here along Sir Francis Drake and saw the beautiful new green golf course that opened today during what has been declared a water shortage emergency. It looks like that only thing that is going to suffer as a result of the water shortage emergency is the water releases from Kent Lake into the principal tributary of Tomales Bay, Lagunitas Creek. And in the next week or two, there is going to be an adjustment in the releases. There has been really nothing said about it. But this is what is going to occur. So, while we sit out here and are concerned about the Bay, this is something that is going to happen in the next two weeks.

The person to write to would be the Director of Water Rights, whose name is Walter Petit. They are going to change the water releases which is going to impact on current studies which are going to be skewed. During this particular time, people in East Marin have clean BMWs, they have watered lawns, they have a new goddamn golf course and you are getting not much water in Lagunitas Creek. And I think we ought to yell and scream about it. Because I think it has an impact on the Bay.

**Dr. Smith:** If I can comment on that, I agree with a lot of what you are saying but I think that one of the things that really comes up with this is the value for long-term monitoring because you have said it's going to have an impact. The question is, will it have an impact? We don't know. Take sea level or tides, for example. It's well accepted that many different places throughout the world, have tide gauges. Because those tide gauges are there for long periods of time, we have some valuable record about what's going on. Consider the reduction of water releases into the Bay. I think we can all speculate as to what effect it might have. But the fact is, unless we gather data, we don't really know.

Now, we'll be in one sense fortunate with this sort of change in that this sort of change will come immediately after there have been two contiguous years of data collected. So we'll have some idea about what the impact is. And I would just like to emphasize that either for a program like mine or for a program like Jon Shenker's or any of the others that you have heard mentioned today, it's very important to have good baseline data. We heard, as an example, that there is a real problem knowing what effect the recent oil spill in San Francisco Bay has had on the bird population, essentially because there were not adequate baseline data.

**Q.** It was my understanding that Tomales Bay is included under the protection of the Farallons National Marine Sanctuary and that accords it special status under federal laws.

**Panelist:** That is correct. It's a large preserve, though, and they have been focussing a lot of attention at the Farallons.

**Q.** I'd like to speak to the issue of aquaculture and the issuance of leases. Ten years ago, representatives of the Inverness Foundation, the Tomales Bay Association, the Environmental Action Committee, Marin Conservation League met at the Park headquarters with representatives of the Army Corps of Engineers, Department of Fish and Game, among others. And we were assured that if these aquacultural leases were to work, all other uses of the Bay still would be possible, particularly boating. Now, it didn't work out that way as you yachtsmen know. You would never wish to take a sailboat or motor boat near the oyster or mussel beds. It would be a hazardous

thing both for me and for the oyster people. I am concerned at having these leases in what we would call "navigable" waters. And I think that we ought to be aware of the fact that things have not been as they were stated.

**J. Finger:** I'll say something about that. I first got involved in mariculture on Tomales Bay in the early Eighties for another oyster company up here that has long since been gone. At that time, the Local Coastal Program was being drawn up which addressed, among other things, the various interactive uses of Tomales Bay. I believe at that time there was a lot of community interaction. I remember going to hearings at Marin County where there was opposition to oyster leases or mariculture all over the Bay.

I'm a boatsman and would like to have recreational possibilities also. I think what I tried to do in my talk is to say that the leases that we are talking about are the ones that were talked about in 1982 when it was decided that approximately ten percent or so of the Bay was suitable for mariculture and that this would avoid most conflicts with the recreational boating community. I don't think you are ever going to avoid all conflicts. There are going to be overlapping uses and we are going to have to do our best to work out compromises.

**Dr. Josselyn:** And with that, I am going to thank our panelists and turn our podium back over to Corwin Mocine.

**Corwin Mocine:** I understand that Senator Marks is here. He has long been interested in the Bay and responsive to our concerns about the Bay, and I would like to give him a chance to say a word to us.

**CLOSING REMARKS**  
**Senator Milton Marks**  
**3d District**

Thank you very much. I am pleased to be here. I was here all afternoon and heard all the afternoon discussions. I think they were great. I am also very impressed with the fact that so many people have turned out for this meeting. It is really a great thing that so many people are concerned about Tomales Bay and I appreciate the fact that you have shown this great interest in it.

While I was sitting back there, I was listening to the statement that there was no broad agency of government looking at the whole question of Tomales Bay. I will be glad to try to see if I can get some money appropriated (maybe the Governor will sign it, which I doubt) I will be glad to try my very best to get some money to try to help in this regard because I think it is very important that we do have some broad agency of government looking at the problems with which you and I are concerned. We do have an agency of government that is looking at some of the problems relating to the San Francisco Bay. The BCDC does make some effort to try to do something about San Francisco Bay and I think that's helpful.

Let me say to you that I am very much concerned with the problems of Tomales Bay. I am not only a resident of this area, but obviously I represent it in the State - Legislature and so therefore I am concerned about your problems. I am concerned about all the problems of the Bay Area. Anything that I can do to help, any service that I can give to you is something that I would like to do. I would hope that you would call upon me. I think that the environmental nature of our community is really very important. There's nothing more important than our environment and

there's nothing we can do better than to protect our environment. If we hurt the environment, then it is gone forever.

I am proud to have initiated the Environmental License Plate Fund, the fund to which you contribute when your vanity allows you to buy a license plate with your name on it. All that money goes to help the environment. It's not a tax. If you don't want a personalized license late, you don't have to buy one. But if you do, all that money goes to help the environment. I thank you very much for the opportunity of being here with you. I look forward to meeting many of you during the social hour and having an opportunity to discuss any, of the things you are concerned with. I don't know whether time permits it, but if you want to ask me a question, I'll be glad to answer a question or two or three.

Yes?

**Q.** Senator, I gather that the Santa Rosa sewage problem is far more amenable to a political solution than it is to a scientific solution. I saw Dr. Hollibaugh's slides showing the effluent that came from the Russian River having a direct influence upon us because I can just see it coming from the Estero Americano right down into Tomales Bay. I am sure that the people in Santa Rosa don't care what the solution to their problem is so long as the problem goes away. Who is protecting our environment, on a political basis, right here on Tomales Bay, to make sure that we get an even say in the solution?

**A.** I hope I am. I am trying my very best to do so. Santa Rosa is not in my area, at least not at the moment. I am the Chairman of the Committee that is going to handle reapportionment so that may have something to do with it. But I think any legislator has a responsibility to protect the things that you and I are concerned with. If they don't, then maybe they shouldn't be there.

Once again, if you don't have a question, let me again advise you that I would like very much to have you notify me of things that you are concerned with. I am an unusual politician because my home telephone number is in the telephone book.' I get some extremely interesting telephone calls. Thank you all very much

**Corwin Mocine** Well, we're almost at the end of the afternoon session. I would like to say one word though. Several of our speakers have said to us, let us hear from you. Help us to get things started here. I would suggest that one way that we can do that is to support the organizations that have put this session together, that is, the Environmental Action Committee, the Tomales Bay Association and the Inverness Foundation. It might be interesting to some of you to know that the abortive application to the San Francisco Foundation grew out of an original application started by these organizations right here. We didn't have any better luck with it than the scientists did, but we at least saw the need and took the first steps to get that program under way.

I don't think any of us is willing to say now that the movement is over with. We are only at a point where we don't quite know where to go next but we're determined to go somewhere. So, remember that you do have organizations here in the community that will play a part in the overall role of getting policy made and decided and carried out. And, give your support to those organizations. There are, I think, membership forms on the table in the hall for all of those organizations.

Now, at this point, let me thank all of our speakers and all of you for a most productive afternoon. In order that we can set up tables now for dinner, I urge and invite all of you to go downstairs to where the exhibits are and where there will be a wine and beer no host bar for thirty minutes while the tables get set up and we have our promised barbecued salmon.

#### SOURCES of INFORMATION

California Coastal Commission, 631 Howard Street, San Francisco, CA 94105; Phone 415 543 8555.

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Dr. Michael Josselyn, Director, Tiburon Center for Environmental Studies, P.O.Box 855, Tiburon, CA 94920; Phone 415 435 1717.

John Kelley, Field Ecologist, Audubon Canyon Ranch, Cypress Grove, P.O.Box 753, Marshall, CA 94940.

Marin Community Foundation, Attn: Art Mills, 1100 Larkspur Landing Circle, Larkspur, CA 94937; Phone 415 461 3333.

Senator Milton Marks, 5035 State Capitol, Sacramento, CA 94937. Phone: 916 445 1412 (Sacramento); 415 479 6612 (San Rafael).

National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

Dr. Jon Shenker, Bodega Marine Lab, P.O. Box 247, Bodega Bay, CA 94923; Phone 707 875 2211.

Dr. Stephen Smith, Department of Oceanography, University of Hawaii, Honolulu, Hawaii 96822.

Suer, Anna L., 1987 The Herring of San Francisco and Tomales Bays, The Ocean Research Institute, 2789 25th St, San Francisco, CA 94110.

United States Geological Survey Office, Western Regional Headquarters, 345 Middlefield Road, Menlo Park, CA 94025 Phone: 415 853 8300.

United States Charting and Geodetic Survey Office; National Oceanic and Atmospheric Administration; Rockville, Maryland, 20852; Attn. Rear Admiral Wesley B. Hull, Director, Charting and Geodetic Services.

## CALIFORNIA STATE COASTAL CONSERVANCY

1330 BROADWAY, SUITE 1100  
OAKLAND, CA 94612  
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August 29, 1988

Thank you for your kind invitation to attend the State of Tomales Bay conference. There is no need to apologize for not including the Conservancy earlier, as this conference is exactly the type of annual event that we hoped the community would continue after our initial involvement was completed. The Conservancy, at its best, serves as a catalyst with its funding and staff assistance to help initiate resource protection and public access in the coastal zone. The true mark of a successful project is when the local community continues these efforts on a long-term basis; for resources will only be protected by those that see and use them every day -- not by a single agency based far away. I am very excited to see how much has been accomplished in the Tomales Bay region since my early involvement in 1982. Thank you very much for sharing the news that interest in the Bay's resources is alive and growing.

I will be leaving the Conservancy this month to go to work at Philip Williams and Associates and attend school. Thus, I will be unable to attend the conference as a representative of the agency. I have passed your invitation to Liza Riddle, Enhancement Program Manager, however, and you should receive some response from her regarding attendance.

Again, I appreciate your thoughtfulness in including me in your plans and I wish you and the other conference organizers every success for the event and the future of Tomales Bay.

Yours Very Truly,

Alyse M. Jacobson  
Senior Analyst

## CALIFORNIA COASTAL COMMISSION

NORTH COAST AREA  
431 HOWARD STREET, 4TH FLOOR  
SAN FRANCISCO, CA 94105  
(415) 543-8555



November 8, 1988

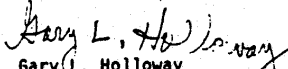
Thank you for the opportunity to attend the first annual State of Tomales Bay Conference on Saturday, 22 October 1988. I found it very interesting and informative and hope that this will become an annual event. I was particularly impressed with the consistent level of concern for the future of Tomales Bay expressed not only by all speakers, but by everyone that I talked with at the Conference.

My professional concerns center on the obvious need for a Tomales Bay-specific Technical Advisory Committee, based on the very successful model of the Bolinas Lagoon Technical Advisory Committee. This Committee could be composed of both local citizens and knowledgeable professionals with expertise in the habitat of the Bay. More importantly, it would coordinate all of the data, reports and research which has been compiled about the Bay and apply it to any all development proposals. This would tend to be more effective than the somewhat scattered and piecemeal approach to Bay protection which has been the case in the past, with so many diverse interests involved. In Senator Milton Marks' remarks, he supported the formation of such a group and stated that he would seek funding to assist it.

The Conference was a positive beginning at looking comprehensively at the Tomales Bay Region, and making more citizens aware of the problems which were identified in the Marin County Local Coastal Program Unit 2 (North), especially degradation to water and wetland areas and the impact of development on the Bay. The adopted LCP policies try to resolve these and should be the basis of any new Committee's work.

I shall look forward to further participation in this important task.

Most sincerely,

  
Gary L. Holloway  
North Coast Planner

GLH: at



COLLEGE OF MARIN

Re: The Establishment of a Tomales Bay Technical Advisory Committee (TBTAC)

Date: November 1, 1988

As a long-time scientist and educator in Marin County (34 years), I am addressing the immediate urgency to establish an inter-community Tomales Bay Advisory Committee (TBTAC). The historical precedent for such a technical advisory committee is the Bolinas Lagoon Technical Advisory Committee (BLTAC). Since 1971, Bolinas Lagoon has enjoyed the advisory system of protection from encroachment and evolution of man-made and natural processes.

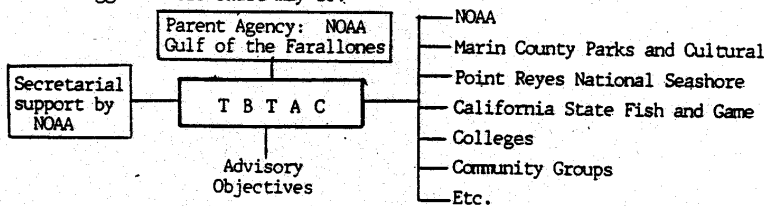
The warnings of the Tomales Bay problems were echoed through your fine conference of October 22nd. Unless action is immediately initiated, the Tomales Bay ecosystem will exponentially self-destruct through a myriad of human and natural variables.

Since Tomales Bay does not have an apparent top authoritative governing body (e.g., Bolinas Lagoon Preserve has the Marin County Board of Supervisors), the process of forming a TBTAC may be guided by the following suggestions:

Steps

1. Call on an independent community agency to initiate the planning of the Tomales Bay Technical Advisory Committee, TBTAC. Such an agency may be the Marin Conservation League.
2. Before convening to establish TBTAC, the agency--Marin Conservation League (MCL)--will undertake to formulate a proposed guideline for TBTAC by conferring with the Bolinas Lagoon Technical Advisory Committee (Chairman: Mr. Skip Schwartz)
3. The agency, MCL, will call a planning meeting with invited representation of inter-community organizations within the Tomales Bay watershed. The guidelines of Step 2 will be presented to this Tomales Bay consortium. A revision of "objectives for the TBTAC" will be formulated.

Suggested flowchart may be:



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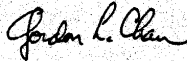


Establishment of a Tomales Bay  
Technical Advisory Committee

4. Present the plan to the community of Tomales Bay. Undertake advisement from the community to the TBTAC plan.
5. Present the final plan and timetable for the TBTAC to all involved agencies and organizations for their approval/adoption and the inauguration of this advisory committee.

This TBTAC task is fraught with a mountain of problems and shortcomings, and it will engulf the initiators who will expend much time and energy. Such events will require people with courage and a commitment to the vision of a more viable life for the entire Tomales Bay Community.

Sincerely,



Gordon L. Chan, Ph.D.  
Biology Department

cc: Mrs. Karin Urquhart  
Executive Director  
Marin Conservation League

Mr. Miles Croom  
NOAA, Sanctuary Manager  
Gulf of the Farallones

Mr. Skip Schwartz  
Bolinas Lagoon Technical  
Advisory Committee

Willis Evans - Fisheries Biologist  
Box 422  
San Geronimo, CA 94963

I believe that the main thrust or message of the conference, based on the speakers selected, was emphasis on the need for additional research. Research is important, but it is not the current primary need for the protection and proper management of Tomales Bay.

The true needs must somehow be brought into clearer focus. These are:

1. To develop an organization or coalition that will administratively guide and direct coordinated planning, decision making, and action regarding Tomales Bay.

2. Formation of a Technical Advisory Group that will provide technical guidance to the administrative body on the present and future management of the bay.

3. Recognition of the major threats to Tomales Bay and its future. These are believed to be.

a. Adverse changes in the environment:

(1) Erosion and sedimentation of the bay.- Recognize its harm and study how to reduce it to an acceptable level.

(2) Loss of fresh water inflow.- This is difficult to assess, as to impact. It is equally difficult to stem the gradual loss of inflow. The proper question may be: What will be the impact on the bay of continuing reduction of freshwater inflow?

(3) Are we adequately safeguarding the bay against pollution or degradation of water quality?

b. Adverse changes in land and water activities that lead to conflict of bay uses.

(1) Is public access to, and use of the bay margin sufficient for the future?

(2) Is the proliferation of commercial oyster allotments around the margin of the bay the best and highest use of the bay?

(3) To what extent should the resources of the bay, such as fish and waterfowl, and shellfish be commercially exploited?

(6) Will the filling of the bay with sediments threaten or curtail boating uses in the future?

c. How are we going to administer the bay with so many different controlling agencies and diverse interests?

A follow-up effort should be made to retain the momentum initiated by the conference through the holding of another meeting in the not too distant future that will present specific discussions of the key problems and their solutions. Oh yes, and the salmon was delicious!

Phyllis M. Faber  
212 Del Casa Drive  
Mill Valley, California 94941  
(415) 388-6002


November 5, 1988

Sorry my comments haven't gotten to you by the 1st but here they are for whatever they are worth. First of all, I think the conference was a huge success and you should be very pleased. There is obviously a need for such an event and for that kind of information. I particularly liked the fact that some physical data is being collected on the bay. That should be published and expanded as money allows. It was interesting how little information was available on the bay. For example, there was only commercial knowledge of invertebrates, little of anything native. There should be information developed about native plants, mapped eelgrass beds. There was little information about how fish use the bay, mostly what is in the bay. The greatest information was about birds and clearly there are more people looking at them.

A few ideas for the future: a session on land use surrounding the bay. What farms are in what use? What are the rules regarding plowing adjacent to the bay, septic tank monitoring, taking of shellfish, things that impact the quality of the bay. I am constantly amazed that the E. coli from cows is equated with human coli and thus the oyster people are needlessly restricted in the winter. Public health should state why they don't differentiate between the two colis. I think the Santa Rosa sewer project was well aired and will be non-existent by next year. Hope so.

Sorry this is so short but I am running to catch a plane. I think a session on stream restoration would be helpful. How, who is doing it, is it successful etc. What about grazing practices? who is doing what?

Hope you will have another state of Tomales next year or soon thereafter.

 **David W. Smith Consulting**  
Water Quality & Aquatic Toxicology

November 4, 1988

Subject: Comments on 1988 Conference

I wish to commend you, the other organizers and participants for providing a very informative program. I am a consultant to the City of Santa Rosa and am conducting studies of the Estero Americano that are similar in scope and focus to the Tomales Bay studies described at the conference. The conference was an excellent opportunity for me as a scientist and as a consultant to learn about Tomales Bay. I feel that the participating scientists provided a good description of their study objectives, methods and results that was of interest to fellow scientists as well as interested citizens. Very productive discussions took place during the banquet and I encourage organizers of any future conference to provide a similar opportunity for such intercourse. The food served at the conference deserves special note; it was wonderful.

I was interested to hear at the conference that freshwater discharges to Tomales Bay were declining and that they are believed to be an important and desirable component of a balanced ecosystem in Tomales Bay. The results of our work suggests that this is also true for Estero Americano.

Your conference provided the first of what I hope will be a series of discussions involving scientists and interested citizens about a possible discharge to Estero Americano. In future discussions, I think it would be useful if the facts about the City's system were provided as a basis for the discussion. When participating in such a discussion, I hope that scientists will fulfill their obligation to the public to distinguish between their personal bias/opinion and their findings that are based on scientifically valid studies.

Current studies of the Estero and Bodega Bay are designed to address the concerns that were raised at the conference. As results become available I and other City representatives would be pleased to discuss the results with scientists, oyster growers and citizens who are interested in the Estero and Tomales Bay.

7040 Sayre Drive  
Oakland, California 94611  
415 339-0582

Sincerely,

  
David W. Smith, Ph.D.