Habitat Conservation Plans: The Way Forward

Minutes of Workshop 27th – 28th April, 1999

Workshop Participants

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Deborah Brosnan, SEI (Workshop Leader)
Jimmy Bullock, International Paper
Steven Courtney, SEI (Moderator)
Tim Cullinan, National Audubon Society
Jim Erckmann, Seattle Public Utilities
Maureen Frisch, Simpson Investment Company
Jim Gaither, The Nature Conservancy
Nancy Green, US Forest Service
Richard Hannan, US Fish and Wildlife Service
Laura Hood, Defenders of Wildlife
Patrick Kelly, Endangered Species Recovery Prg.
Nathan Lichti, SEI
Ronald Pulliam, Univ. Georgia (Workshop Leader)
Sat Tamaribuchi, The Irvine Company
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Introduction 4/27/99

Reichman (Director NCEAS) welcomed the workshop participants and outlined the opportunities for use of the center.

Pulliam and Brosnan (workshop leaders) welcomed the participants, and expressed thanks to the center and to those who had helped bring the *Group* together. *Courtney* acted as moderator for the workshop.

Pulliam opened the discussion by listing common beliefs held by the participants, and the reasons for convening:

1. *A conviction that economic and ecological health are compatible goals.* There is no need for 'train wrecks' in conservation planning. In the long run, it is in everyone's interest to make such planning successful.
2. *There has been a lot of effort in the past to reconcile human and ecological needs.* Still, there is room for improvement. We should try to use the best methods in conservation planning.
3. *Science can help us do this job better.* However this needs appropriate caution; science isn't everything, and can only contribute to a good plan. However we can all agree that better scientific information will help in the planning process. This may be in areas of credibility, or in resolving problems.

If we agree on these common beliefs, what steps can we now take? There has already been a lot of effort devoted to this topic, which the workshop will build on.

Until recently, we have needed an assessment of where we are. What was needed was an honest look, or analysis, which evaluated both successes and failures. This should not be interpreted as finger-pointing or an attempt to say that the system is broken – rather as an attempt to learn from the past, and to improve in the future.

The first step in this process then is to evaluate the studies which are now in place (including an understanding of the studies' own limitations). The second step is to take a hard look at what we can do better, and to what extent science and scientists can help.

Brosnan outlined the workshop goals. These were to focus on the positive lessons that can be learned, and on the roles of scientists in building stronger conservation plans. SEI was founded with the objective of integrating sound science into management. The institute has taken the lead in convening this workshop because the time is now ripe to evaluate past success, and to move forward. Our goals should be better management and making scientific support more available and efficient.

The participants introduced themselves and their backgrounds.

Courtney then asked the participants to outline their involvement with HCPs and to answer the following question. What <u>one</u> thing would the person like to change about the use of science in HCPs? *Courtney* described his role as scientist and scientific moderator in some HCPs, including the recent Pacific Lumber plan. He felt that there was an increased need for science at every stage of the process, from scoping to implementation.

Erckmann is lead planner and scientist for the Cedar Creek HCP (Seattle Public Utility District), which has been under negotiation for 5 years. He supported increased use of science, but noted that it can be difficult to select the appropriate scientists, particularly when soliciting independent input. He did not use scientists as an independent science panel, and regrets this now (it would probably have speeded the process). However, individual scientists were used as consultants and advisors (typically highly respected academics). His 'single most important change' would be for scientists to provide a more useful definition of 'take.' This is an ambiguous concept and is difficult to apply to fish, which are affected by for instance water flow. This can cause problems when we are trying to estimate take and the effect of take on a population.

Hannan commented on some of these points, and acknowledged that we need, collectively, to do a better job in integrating science into ESA issues (not just HCPs). We may need to acknowledge that take of salmon is a different concept from take of vernal shrimp. It may be that we have to use the best professional judgement of scientists for some time. USFWS does the best job it can – is committed to seeking scientific input. However he noted that science is not always unifying – science proceeds by argument, and always will do. Therefore we should not expect too much of science.

Bullock assisted in the development and implementation of International Paper's HCPs, including the recent Red Cockaded Woodpecker plan, which involves credits and incentives for exceeding conservation goals. He feels that HCPs need to remain a viable tool in conservation management. However there needs to be clear incentive for the landowner to develop a stronger scientific basis for a plan, given the potential for increased costs and longer development times. He welcomed the opportunity for incentive based management, where landowners could be encouraged to reach out beyond the current standard to one of contributing to and advancing recovery. His 'single most important change' would be for scientists to provide a better definition for 'acceptable risk' He noted that a manager will always be faced with the situation that there is not enough science to answer all possible questions. An HCP is a negotiated agreement, which science can only help to inform. 'Science' is a contributor to the process, not a goal in itself. A suitable benchmark for acceptable risk in HCPs may be: after implementation 'is the species better off than at the start of the process?'

Andelman and *Cullinan* pointed out that it was hard to make a call on 'better off', which can be scale and time dependent. This is not the standard in the law at present, which has no recovery standard. Many applicants (such as International Paper) may be interested in doing more: *Bullock* argued that we may perhaps need a new way to codify such agreements, beyond HCPs.

Courtney commented on risk, and the reluctance of scientists to specify risks for decision-makers. It is important for scientists to provide decision-making tools. This may include advice on the quality of the science itself. SEI policy is that each of our scientific reports not only states recommendations, but also the degree of confidence we have in them. This allows the decision-maker to make his or her own judgement on the work (if we are, for instance, tentative about conclusions). However scientists don't like to point out the weaknesses in their own work – it goes against our normal behaviour and training, which is always to present the best possible case. *Brosnan* pointed out that this also comes from scientists usually writing for other scientists, who will recognize speculation for what it is; scientists need to write differently when addressing a broader audience.

Gaither has a background in both science and its application at individual and policy levels. The Nature Conservancy is adopting a more proactive approach, with a focus on communities and ecosystems. This sort of approach can be powerful as a conservation tool, and may avoid future listings. If HCPs can become proactive, then this will benefit species and ecosystems.

Gaither pointed out that science is a process, not an endpoint or goal in itself. A commitment to good science is therefore a commitment to the scientific process, not simply scientific information. This is both more challenging and more powerful. It implies an iterative process of improvement. He identified not one but four changes or recommendations. Science should be involved in all stages of the HCP process from negotiation to implementation; moreover it should function as the unifying principle or link that ties together these stages. Recommendations:

1. Science should promote negotiations that are 'interest' or 'process' oriented rather than position based. For instance, the goals and the terms of negotiation over an aquatic strategy should be focussed on 'providing good fish habitat function' rather than 'are the buffers 30 or 200 feet'.
2. Uncertainty should be made explicit. Murphy and Noon have done this for spotted owls; other approaches (Bayesian and others) are possible. Where possible, the likelihood of alternative outcomes should be specified.
3. Articulate the decision-space of decision-makers. What flexibility is present? This will involve an explicit statement of all costs.

4. Use 1,2, and 3 to inform the design of adaptive management and monitoring.

Pulliam liked this set of suggestions, but pointed out that the term 'interest-based' was prone to misinterpretation as relating to 'interest group.' *Courtney* pointed out that iterative processes were not always possible at the level of individual HCPs, some of which (e.g. small developments) involved irrevocable changes.

Pulliam argued for the use of CSP or 'consensus science planning' in HCPs. Essentially this approach calls for all parties to agree on a common process, with cooperative development of the necessary data. This approach avoids the problems inherent in advocacy based approaches, where each party develops their own data or analyses, and attempts to 'win' a scientific argument. Since each scientist tends to become invested in his or her own analysis, agreement is harder to reach after each group has completed their analysis. In CSP, scientists come together before planning starts. They then decide how to do the necessary science, and cooperate on every stage through to analysis and development of recommendations. Practically, this may be difficult in HCPs, where applicants may not approach the regulatory agencies until they have a plan fully developed. Early involvement of scientists is preferable

Pulliam sees three ways to proceed using CSP.

1. *Joint Research Planning*. This is a proactive procedure, where scientific research is planned cooperatively, and then used to inform future negotiations.
2. *Joint Research Evaluation.* This is retroactive, and considers work that has already been done, on the proposed action area or elsewhere. Techniques such as meta-analysis are very powerful, formal approaches that are now available.
3. *Joint Monitoring.* This may be carried out through and after HCP negotiations.

At all stages, the involvement of statisticians is key. Appropriate statistical design is important to ensure that research or monitoring results can be interpreted unambiguously.

Courtney pointed out that already we were seeing an emergent theme: science as an iterative process, which should inform all aspects of HCP development and implementation. It is essential that this science be well designed, with appropriate statistical help.

Tamaribuchi described the Orange County NCCP/HCP, which has an emphasis on adaptive management. Reserve management is in the hands of a non-profit corporation, which is guided by local government, landowners, environmentalists, business and recreational interests, and by the agencies. With an annuity of $10m, and an annual budget of about $500,000 for restoration, this is a very forward looking program. In addition the group is aggressive about seeking other funds, through grants, and engages in mandatory restoration, fire management etc. He emphasized the need for certainty in the HCP process, and that large-scale HCPs are inherently better suited to planning for ecologically variable systems.

Frisch described Simpson's several HCP efforts: a completed spotted owl plan in northern California, and three other plans in different stages of development. A marbled murrelet plan in California has taken 6 ½ years and is incomplete. A similar aquatics plan has so far taken 5 years. A Washington state aquatics plan for 214,000 acres is under final negotiation, and will be submitted soon; it will bridge ESA and Clean Water Act concerns. Simpson's position is to invest heavily in science, and to allow the results to take management wherever is appropriate. This position has borne dividends, for instance with spotted owls, where heavy investment in research has created management opportunities. Originally, few owls were thought to exist on Simpson lands, because specified habitat conditions were rare. However, owls occur in many more habitat types than originally thought, and Simpson harbors a major population of this threatened species. *Frisch* noted the scientific opportunities of such extensive dedicated resources: scientists can be helped to do interesting and innovative work. Simpson is ready to go beyond the accepted standard, towards helping recovery, but needs some certainty in its own business.

Frisch highlighted several issues:

1. *Science should be locally applicable*. Where possible it should be done locally. Conditions vary, and research carried out elsewhere may be of limited use to the applicant. 'Cookie cutter' approaches, where the same standards were applied to all HCPs or other plans, will miss important differences both between landscapes and between applicants.
2. *The HCP process is very lengthy; use of science that shortens the process would be helpful.* HCPs are now incredibly complex and expensive to develop and implement.
3. *Agencies are understaffed and underfunded.* This lengthens the process further. Scientific help would aid the process.
4. *Individuals within regulatory agencies leave their positions.* This results in a loss of understanding of context, and changes in interpretation of science and agreements.
5. *Smaller landowners will not have the resources to carry out large scale analyses.*
6. *Templates from one HCP are applied to others* (for instance Pacific Lumber standards applied to Simpson). This ignores local conditions.

Cullinan noted that Simpson's heavy initial and continuing investment both in research and in description of their land and timber base in Washington was one factor which made the HCP negotiations more productive. *Frisch* noted that Simpson's biologist has identified 49 stream types, as compared to the 5 recognized by the state.

Good science does not ensure a smooth process; however *Hannan* emphasized that it will be useful. Regarding *Frisch*'s points: #2,3. The agencies face many issues with development of HCPs. Most importantly, they do not have adequate resources or personnel. Investment needs and demands on resources never let up. This will inevitably lead to delays in approval and evaluation of HCPs. In that good science and independent science can alleviate this problem, it will be most useful. Point #5. When dealing with smaller landowners, it is still possible to integrate sound science (from elsewhere) into these HCPs without committing major new resources.

Hannan noted that it is always difficult to provide complete assurance or certainty: science is a process, not a product. Even a good HCP is not immune from a lawsuit, including challenges to the scientific basis. The applicants need therefore to do as good a job as possible, as do the agencies.

Courtney noted that we need to recognize the tension between 'providing certainty' and the explicit uncertainties of science. The best way to do this may be to be honest and open about what we do and do not know. Local science is also important – no clearer than in the case of Simpson's land, where new research changed our understanding of how spotted owls use habitat. However there is a tension between local science, which is more precise to local conditions, and synthesis (using more powerful statistics such as meta-analysis) which is only possible at very large scales, across regions and ownerships – we need both.

Science will not become appreciably quicker. If we bring more resources to ecological science, we can speed things up a little, and certainly produce better answers – but the timescales are still likely to be in years. If planners need to make decisions in months, then there needs to be a recognition that this will bring uncertainty. The appropriate response may then be incorporation of adaptive procedures into the plan.

Regarding the use of science in HCPs, there is a real problem concerning the availability of resources. A large applicant may have the resources to engage in scientific studies. A small applicant, however, is far less likely to have the money. It is also unlikely that an agency will be able to step in to fill the gap. Examples of such issues include management of meta-populations, as with some butterflies. In order to manage a particular population (such as might occur on a small ownership), we need information on the connections between this population and the global population, on dispersal rates between these areas, and we may well need a Population Viability Analysis. Given that neither applicant nor agency has the resources to get these data, there is a need for another group to provide scientific expertise and advise.

Many scientists would like to do more: they don't have a role other than advocacy. We need to find ways to involve them in HCP planning, without making them advocates. This may require new incentives or rewards.

Outside scientists involved in the development of an HCP should not be asked, and typically will not agree, to defend a particular compromise or decision that was made by decision-makers during negotiations. However, at least sometimes, they will make statements on the quality of the scientific approaches, data and analyses that were performed to inform those decisions.

Hood noted that the timing of scientific involvement was critical. Scientists are often engaged too late in the process to improve the product and reduce the biological uncertainty in a plan. She noted that scientific processes could be used to reduce these uncertainties. The workshop topics are all areas where improvements could be made. She suggested three topics that would reduce the concerns of citizens.

1. Greater involvement of independent scientists
2. Additional funding and mechanisms for improved science and public involvement
3. New infrastructure that would promote increased and early scientific involvement

We should come out of this workshop as advocates for a new infrastructure and procedure for involving scientists.

A distinction was made between biological uncertainty, which affects the probability of success of a conservation plan, and uncertainty for the planner (such as the landowner). Science, early in the process, can help us identify areas of biological uncertainty, and then motivate the essential studies or synthesis that can resolve that uncertainty.

Hannan, in response, noted that the 5 point policy, recently articulated, was specifically crafted to deal with uncertainty (through adaptive management, monitoring etc.). However there are essentially two types of HCPs: the public process (e.g. WA DNR, Cedar Creek) and the private HCP (usually applicant driven, and difficult to anticipate). An essential item for discussion is why a private applicant should be motivated to involve independent scientists. How would this reduce costs, or speed up the process?

The *Group* supported the 5 points as a good step, but recognized that the agencies were critically short of resources. *Erckmann* suggested some pooling of resources to help this.

Pulliam suggested that a valuable new approach might be for there to be uniform scientific standards and guidelines for monitoring (set by the agencies), but a recognition that each plan is idiosyncratic in its other provisions. Interior will never have the resources to do the monitoring: but they should set scientific standards that can otherwise vary dramatically.

Tamaribuchi questioned whether USFWS would be willing or able to delegate authority or responsibilities in some circumstances. For instance, if an appropriate group (local government?) could take over responsibility for ensuring monitoring. (Note the cooperative non-profit that runs monitoring and mitigation on the Orange County NCCP/HCP). Would such delegation require development of trust between the parties? If implemented, such changes could reduce demands on USFWS resources. *Hannan* agreed that this may be a good way forward in some circumstances, which may diminish the burden on USFWS. *Courtney* pointed out that citizen resources can be used for monitoring (e.g. salmon in the Northwest). *Frisch* agreed that the NW salmon may begin a new model for cooperative involvement of citizens and government.

Andelman supported the call for standards and guidelines in monitoring, which is a global concern.

Brosnan pointed out that, looking at the development of individual HCPs, it is clear that they often reinvent the wheel; each applicant learns the same lessons independently. Some applicants recognize early the role for scientific input; others have to take corrective action later. It would be more effective if applicants could learn from the previous experiences of others. Workshops, seminars, and training sessions may help here. A core group of scientists who are available to work on many HCPs might also be really valuable. SEI has developed some ideas along these lines, to make scientists available.

Gaither stated that there seems to be agreement that existing structures and organizations will not be able to meet some of the challenges on integrating science into the process, even if more money and staff are dedicated to the tasks. For instance the regulatory agencies or the applicants are often concerned with defending their actions or 'the HCP.' This understandable response to ongoing threats of litigation does not encourage participation in an open scientific process. An open process may be seen by the applicant as encouraging litigation. So we need to articulate how science can help all parties, and train scientists accordingly.

Erckmann agreed that applicants often think defensively, and stated that he is sometimes discouraged by lawyers from stating uncertainty. *Brosnan* questioned whether an upfront, clear statement about uncertainty would actually be a defensive step. It is better to state what risk is involved than attempt to hide it. The precautionary principle is good science and more defensible.

Green stated that in the Forest Service a statement of uncertainty was absolutely critical. For instance, in the science consistency check process, as applied to the Tongass Forest Plan, three questions were asked:

1. Was the best science used?
2. Was the interpretation appropriate?
3. Were risks acknowledged?

If the risks were acknowledged, the plans were MORE, not less, defensible. This would indicate that decision-makers were fully informed, and had all the available information prior to making decisions.

Green also stated that her preferred 'one change in the use of science in HCPs' would be to provide a larger scale framework that included other landowners. The Forest Service is sometimes 'surprised' by HCPs that transfer burdens to the federal agencies. This is also an issue with monitoring, where the appropriate scale may be larger than the individual ownership. It should not be left to overcommitted agencies to pull this together. Other groups (NAS, SCB, ESA etc.) need to give guidance on appropriate science and monitoring.

Pulliam noted that success stories need to be brought out, not only in HCPs, but also in other cooperative endeavors that cut across constituencies and agencies. Examples include the multi-partner development of land classification systems and the amphibian monitoring scheme.

Bullock indicated that when involving outside scientists, there is a tension between 'independence' and 'experience.' He is most nervous when groups such as professional societies seek to comment, because such groups typically lack both practical experience and local knowledge that are critical to making an informed judgement. Training can help a little with this, but also there needs to be a recognition that professional societies etc. may not be the appropriate bodies to provide impartial input. *Gaither* and *Courtney* suggested the need for recognition of the role, and training in 'science interpretation.'

Hannan stated that scientists could help by providing guidelines on improving integration of biological goals across scales, as well as integration of monitoring standards. He also discussed the issue of training, and noted that there is already a training center operated by the USFWS. Non-agency participants are encouraged to attend, and would benefit from doing so. Within the DC office, there may also be opportunities for staff from other groups to be 'seconded.' This would allow individuals to better understand the USFWS roles and circumstances. He would be enthusiastic about making such links work.

Previous Studies 4/27/99

Hood introduced the Defenders of Wildlife report "Frayed Safety Nets', which she authored. Defenders feels that HCPs have great potential as a conservation tool, but they want to see these plans improved. Some concerns, which may fall outside the scope of this workshop, are:

1. Adequacy of funding for mitigation and monitoring, and any changes that might become necessary.
2. Legal and other aspects of the no-surprises policy
3. Use of a recovery standard.

Hood introduced her study, and outlined its scope. She went on to discuss her findings on the types of scientific input to HCPs. She identified three major forms of input:

1. A Technical Advisory Committee
2. Independent, 'one by one' consultancy with individual outside scientists
3. A formal peer review process.

Only 2 of 24 HCPs in her study used formal peer review. One, the San Bruno plan, the first successful HCP, is still an exemplar. Peer review of initial planning steps helped the final design, and also provided some defense against legal

challenges. The other HCP with effective peer review is the NCCP process.

Monitoring remains a significant concern, with many examples of poor planning. Some small plans, for instance, have either no monitoring or no consideration of the cumulative effect of such plans over the whole landscape. Monitoring may consider the particular species (e.g. San Bruno butterflies) rather than the affected habitat (e.g. hosts of these butterflies) which are of more management concern and applicability. Several large HCPs (e.g. WA DNR, San Diego) have no monitoring decided at the time of HCP permitting (although others such as Volusia Co, MA Piping Plover, have very good monitoring provisions).

Hood also discussed the scientific basis for adaptive management, and how this affected no-surprises provisions. This area warrants a lot more sophisticated development, with clear provisions for feedbacks to management. For instance the MA Piping Plover tied permitting to monitoring, while the WADNR HCP had extensive research provisions which are to be carried out prior to taking any actions on marbled murrelet habitat. However she was less comfortable with multi-species plans where monitoring and adaptive management might be harder to implement.

Frisch pointed out that this study, and also the AIBS/NCEAS study, may miss a lot of information: the application documents don't include background work, including a lot of peer-reviewed science.

Tamaribuchi, commenting on monitoring, noted that some applicants, e.g. Central-Coastal NCCP/HCP non-profit, are ready and willing to step up and fund further investigations when these become necessary (current funding in this HCP area is well beyond that called for in the plan). In the Central-Coastal NCCP/HCP case, the monitoring is now running three times the level agreed to in the plan. The state also funds monitoring, which is an opportunity to provide information on whether HCPs are working.

Andelman summarized the purpose and results of the AIBS/NCEAS study (Kareiva et al 1999). This was an attempt to provide information on the use of science in HCPs, and was sponsored by NCEAS/AIBS after a meeting hosted by EDF in Washington, D.C. in response to widespread discussion over the adequacy of science in conservation planning efforts. It was designed to be an impartial and quantitative study, with as little subjectivity as possible. Most participants in the study (106 students, postdoctoral scientists, and faculty at 8 universities) were not directly involved in HCPs, although each study group included at least one person with such experience.

210 HCPs were scrutinized, and 43 were analyzed in detail. Questionnaires (with over 2000 questions) were applied to the scientific analyses and provisions in the selected HCPs. The focus of the study was very much on the use of science. It should be recognized that an HCP is not in itself a scientific process – but it may be crafted using science. In this study, participants evaluated plans on scientific, not legal, criteria. For instance, the scientific criteria for what the study considered to be a 'quantitative estimate of take' differed, in some cases, from the operating definitions used by the USFWS. Decision-makers might evaluate the sufficiency of such measures very differently from scientists.

HCP provisions were considered at 5 stages (species status, take estimate, effect, mitigation, monitoring), with evaluations of scientific adequacy or excellence at each. Plans varied widely in their use of science. Approximately half of the plans considered did not, for instance, provide an explicit, quantitative estimate of take (although USFWS disagrees with this interpretation).

Ideally, planners that had less data available to them would recognize the need for adaptive management. In the AIBS study, plans with 'insufficient data' were *less* likely to discuss adaptive management. *Pulliam* noted that this may be an artifact of small plans relying on fewer data and also having fewer opportunities for adaptive management.

Only 50% of plans had a biological monitoring program. Only 15% of plans had biological monitoring programs that were linked to factors that could evaluate a plan's success. Several plans, however (e.g. WA DNR), left monitoring plans unspecified until such time as research had indicated what was necessary (Cooperative monitoring design).

Recommendations of the study group included:

1. Develop explicit scientific standards
2. Encourage explicit acknowledgements of uncertainty and summaries of the data and sources of information upon which plans are based.
3. Information used in developing plans, as well as subsequent monitoring data, should be accessible

4. Independent peer review

Erckmann commented that the study considered the adequacy of science. But it is possible to have a good plan and poor science, as well as a poor plan but good science. What is missing from the AIBS/NCEAS study is more information on the context of the plan. For instance a good plan may be entirely devoid of some critical data, and then proceed in such a cautious manner that no risks are taken with the wildlife. In the WADNR HCP, insufficient data were available to plan for marbled murrelets. The agency elected to undertake a plan of research rather than begin habitat modification. This plan scored poorly in the AIBS/NCEAS study (Kareiva et al 1998; Bigger 1999) but was nevertheless a good and cautious plan. The AIBS/NCEAS study could be taken further, and would be more useful as a consequence.

Pulliam pointed out that the study set an impossible standard in some regards; for instance there is very often no easy way to translate habitat loss to impact on a species. Hence critiques of HCPs are really critiques of conservation biology as a whole. *Andelman* agreed, but pointed out that there are no clearly articulated biological standards in the regulations or elsewhere – the AIBS/NCEAS study group first had to set up a set of standards themselves, before investigating any HCPs.

Hannan felt that the AIBS/NCEAS study had critiqued HCP science without due emphasis on the available positive lessons. This meant that the useful aspects of the work were lost in the perception by many agency staff that the report was an indictment of their competence and commitment. What is lacking (in the report) is the sense of common purpose in doing a good job, and in learning from experience. We need more guidelines on what to do next, with positive recommendations. *Bullock* and *Frisch* agreed, and emphasized that there was a need to defend the use of HCPs as conservation tools. The Foundation for Habitat Conservation was formed in response to the perceived negative critiques. *Courtney* and *Brosnan* suggested that the responses of the study participants and of agency staff illustrated how managers and scientists typically fail to understand each other's point of view (see paper by *Brosnan* and Manasse). *Andelman* agreed that this was a reflection of the 'clash of cultures', where academics use criticism as part of their everyday practice, and may be insensitive to how this approach may be perceived outside of academia. The *Group* agreed that the positive aspects of the study needed more emphasis, with a commitment to learning from each other's perspective. This lesson could usefully be applied to similar exercises, such as the current study on recovery plans.

Pulliam and *Green* suggested production of a CD or document that described how to craft a good HCP. This would include examples of particular aspects (e.g. WA DNR research, Irvine monitoring, San Bruno panel) that were deemed particularly successful. This would both provide a positive message about the possibilities in HCPs, and at the same time would serve a real need for applicants. *Erckmann* stated that this would have helped him a great deal.

Cullinan and *Hood* emphasized that, whatever the shortcomings of the AIBS/NCEAS study, it still provided much useful information. It is important to capture that useful information, and to build on the experience. A problem of interpretation or perception arises when the public considers the results of the study alongside particular individual HCPs (some of which are undoubtedly deficient). The public may come to the conclusion that all or many HCPs are bad; we should focus instead on the lessons that can be learned from the data. *Cullinan* and *Hood* also emphasized the need for increased use of the precautionary principle when insufficient data were available; these are plans for endangered species where the latitude for mistakes is small. *Pulliam* noted the value of the AIBS/NCEAS study as a 'process check', akin to peer review. As HCP science improves, there will be an increase in credibility and in confidence in the process. *Andelman* noted that without such process checks it would be impossible to know if HCPs were working.

Adaptive Management 4/27/99

Wilhere presented a discussion of adaptive management, describing it as possibly the most difficult habitat conservation planning issue to deal with, because it has no clear consensus definition; the *Group* must come to a common understanding of what constitutes adaptive management. Fifteen definitions of 'adaptive management' were presented in chronological order, and despite their differences, they shared the common theme of 'learning by doing or experimentation.' Thus, adaptive management may be defined as "management intentionally designed to yield reliable information," implying that monitoring and adaptive management strategies should be developed in tandem during the initial formation of conservation plans.

HCPs that incorporate genuine adaptive management would have three general goals: habitat conservation, financial

profit, and the yield of useful, reliable information.

Wilhere outlined various approaches to resource management, stressing that 'adaptive management' leads to the acquisition of knowledge. There are four approaches to modifying management regimes, only two of which constitute true adaptive management. The first of these approaches, deferred action, delays the exploitation or development of the resource until a later time, when there is less risk involved in the action. Reactive management, the second approach, changes the resource use prescriptions only in response to some external driver, such as political or social pressure, or a lawsuit. This strategy, also called crisis management, has predominated resource planning for at least the past two decades.

Two forms of true adaptive management exist, passive and active. Passive adaptive management is the most commonly conceived form. In it, a policy is implemented and its results are monitored over time. The policy is then modified according to the monitoring results, forming a feedback loop. The system may also be modified by external influences, such as research results. Passive adaptive management can have difficulty distinguishing between natural effects and those caused by management. Active management, on the other hand, solves this problem by allowing for the use of control strategies. In the active form, multiple management strategies are implemented simultaneously in different areas, and their effects on the resource are compared. In subsequent iterations, new alternatives are compared and the set of possible successful regimes is narrowed, until one is selected as the best approach.

Real adaptive management can account for the problems of scale which can occur in conservation planning. Most HCPs are based on research which has been carried out over a small spatio-temporal scale, and these results may be extrapolated to larger scales. However, due to non-linear effects, such plans may fall apart. Adaptive management solves this problem by allowing the management prescription to be changed in accordance with new, larger scale data. The experiment and management take place on the same scale.

For planners, trade-offs exist between the various approaches to natural resource management, the choice of strategies depends on several criteria: scientific uncertainty and risk to the resource, the cost of alternative management regimes, and the value placed on the production of information.

Pulliam noted that if a natural disturbance and the management prescription occur on different scales, their effects can be separated. He also cautioned that while active adaptive management compares different hypotheses about the system's functions, and may maximize the amount of data gained, if it is designed with information yield as its main goal, it may result in the extinction of the species (and a good picture of why it went extinct). *Wilhere* agreed that there are added risks to adaptive management which must be considered when planning conservation strategies.

Green expanded upon the fact that adaptive management, if improperly implemented, may lead to the extinction of the species or an ecosystem crash. In many cases, the effects of a management prescription will not be perceived for years or even decades. During this time, there is continuous input from external factors, such as natural disturbances, which further obscures the effects of management. This can result in a time lag between the manifestation of a management effect and its perception, meaning that once the effect is seen, it may be too late for adaptive management to save the system. In order to avoid such outcomes, it is crucial to define a floor or safety net, below which adaptive management may not occur. The Northwest Forest Plan uses a geographical approach to this problem, identifying both reserves and adaptive management areas, so that even if a disaster occurs on the adaptive management lands, the problem will be localized.

Wilhere responded that because adaptive management is used to address uncertain situations, the definition of a floor is problematic. Adaptive management entails a risk, so a safety net is required, but because the system is not understood, adaptive management might be used to determine where the net should be placed.

Green disagreed, arguing that the net can be defined using the best available information. *Erckmann* expanded upon this, adding that the safety net's definition should incorporate an assessment of the risk to the species under various management plans, and that in the case of extreme uncertainty, the precautionary principle should prevail.

In cases of very high risk and uncertainty, adaptive management may have to be replaced by deferred action. *Courtney* illustrated this, noting that timber companies in California are using adaptive management on spotted owls, which are relatively abundant and well understood, but not on marbled murrelets, which are less common and less well known, making the risks posed to them by adaptive approaches inappropriate at this time. *Wilhere* noted that in addition to

deferring timber harvests in murrelet territories, WADNR has implemented a large experimental study of murrelet biology. The results will eventually be used to craft a appropriate conservation strategy.

Courtney reemphasized the importance of risk assessment in defining safety nets, adding that planners must consider both Type I and Type II error and not only the risk of a given approach, but the risk that the assessment of risk itself may be flawed. Scientists must clearly articulate not only what they know, but also what they don't know, and how certain they are of their knowledge.

Wilhere described the No Surprises policy as a fifth approach to natural resource management, similar to reactive management, but without the obligation to react. He then outlined three institutional conditions favoring adaptive management, citing *Compass and Gyroscope* by Kai Lee:

1. Decision makers must be willing to authorize experiments, face their inherent risks, accept their results, and fund them over long periods of time.
2. Scientists must be able to run the experiments, and must therefore posses a basic understanding of the system and have access to the necessary tools and sufficient resources
3. Better alternatives must not exist.

At this point *Wilhere* discussed how adaptive management is currently being used in the habitat conservation planning process. Under Section 10 of the ESA, the Services have the authority to require whatever actions are necessary and appropriate for the conservation of a species when issuing an incidental take permit. However, the administrative regulations defining the No Surprises policy limit this authority to some extent. Changed circumstances which may be reasonably expected to occur during the life of the HCP must be planned for, and if a change occurs, and is provided for in the HCP, the management changes must be implemented. However, the Services may not require adaptation to changed circumstances if they are unforeseen or otherwise not provided for. The letter of the law is therefore unclear as to the limits placed upon adaptive management, which, for a given HCP, ultimately depend upon negotiations between the applicant and the Services.

Pulliam commented that this interpretation depends on the assumption that adaptive management occurs at the same scale as the HCP, which is not necessarily the case. With several small HCPs, adaptation may take place on a larger, regional scale, with the responsibility falling on the Services. Adaptive management is therefore limited, but not precluded, even if specific circumstances are not recognized by a particular HCP.

Wilhere acknowledged this point and continued, citing the Services' HCP Handbook and Addendum. Where significant uncertainty exists, it may be addressed through the incorporation and implementation of adaptive management, which allows for continuing mitigation and the achievement of long-term biological goals. Adaptive management is essential when planning conservation of species for which there exist large information gaps. It is used to examine alternative approaches and to plan and adjust future conservation strategies. The degree to which adaptive management is incorporated into HCPs therefore depends on how far the Services are willing to push and how far the applicant is willing to go. *Hannan* commented that the choice to include adaptive management depends on how much uncertainty there is in the system.

Erckmann noted that many applicants will not enter into adaptive management without pushing, since it may have significant detrimental effects on their future economic wellbeing. They must therefore have some certainty that it will not "blow up in their face." The limits of adaptive management, the exact actions which will take place in the case of specific changed circumstances, and the circumstances themselves (triggers) must be defined.

Gaither cited the Pacific Lumber HCP, stating that for spotted owls, a population trigger served as the criterion for implementing adaptive management. Such a criterion denotes a specific balance between ecological and economic interests, and the position of that balance depends on the level of the trigger. How can science determine such a criterion, which is, by definition, a value judgement?

Wilhere answered that science can provide a whole set of possible balances, along with their associated levels risk to the species. The planners must then decide what degree of risk is acceptable. He then went on to cite the NCEAS/AIBS study, noting that it uses a much simpler definition of adaptive management than was adopted by the current group, describing adaptive management as any provision for a change in management prescriptions. One third of the HCPs studied in the report contained monitoring programs but lacked provisions for change. Why include monitoring if it is not

informing adaptation of the plan? *Courtney* echoed this question.

Hannan and *Pulliam* responded that monitoring may be used to determine the plan's effectiveness, and may inform future plans or larger scale adaptive management, and is legally required of HCPs. Within a particular HCP, adaptive management may or may not be appropriate, depending upon the biological uncertainty associated with the system. Additionally, while monitoring has always been required in HCPs, adaptive management is a relatively new concept, and should not be expected of older plans.

Wilhere concluded by summarizing the concern expressed by various scientists and environmentalists over the perceived conflict between adaptive management and the No Surprises policy.

Courtney ended the discussion, asking whether, by taking up the role of determining the risks involved in various approaches to management, scientists might reduce the tension associated with this issue. However it would be essential to have early involvement of such scientists.

Peer Review 4/28/99

Brosnan presented an introduction to the topic of peer review in habitat conservation planning, explaining that it can be of real value to all concerned, but that there are also obstacles to instituting it (the accompanying handouts give more detail). Many groups are calling for peer review and she provided an overview of this, and a recent poll has shown that 88% of the American public favors peer review of the listing process. However, it is clear that different groups mean different things by peer review.

There are some special considerations when translating the review process to management scenarios. She distinguished between academic peer review and its use in natural resources decision. Academic peer review originated in seventeenth and eighteenth century professional societies, and evolved into the editor and peer reviewer system of today. Thus all reviewers had the same training (scientific) and goals (advancement of science) and all effectively belonged to the same club. Managers and scientists have different training, backgrounds, underlying assumptions, and goals. They ask different questions and interpret information differently. Managers must make a decision regardless of the availability of science.

When involving reviewers in an inherently political process, such as conservation planning, care must be taken to insulate the reviewers from advocacy and maintain their impartial and independent status. Peer review is essential in the HCP process and it should begin early and be continuous. All groups must have confidence in the peer reviewers and thus should be engaged in choosing them. Training is important for reviewers so that they can be effective and maintain their independence.

The existence of a liaison between the scientists and managers is essential for buffering the scientists against undue pressure and for interpreting between science and management questions and information. The liaison should be a qualified scientist who understands the management area. Roles must be clearly defined, especially the roles of manager and scientist. *Brosnan* presented an overview of how the lines between management and science had become blurred for external reviewers in the Tongass Plan.

In the subsequent discussion, *Courtney* (echoing calls from *Hood*, the AIBS/NCEAS study, and elsewhere) emphasized that scientists should be involved in the formation of HCPs as early as possible, even in the initial scoping stage, but *Hannan* countered that because the HCP process is applicant driven, there was no way to force early involvement of scientists. He therefore challenged the *Group*, and the scientific community more generally, to clearly articulate the benefits which an applicant might receive from early scientific involvement.

Courtney pointed out that scientific involvement helps to address and dispense with criticisms while still early in the permitting process, before the plan's basic tenants have become set in stone, but *Erckmann* suggested that a private landowner or company may wish to maintain control over the early phases of plan formation, simply because they do not want outside groups determining the core of their actions and business practices for the plan's duration. *Cullinan* elaborated that when a permit applicant is already an expert and has abundant information on the biological state of their

holdings, they are less likely to desire outside help than when this is not the case, since such help would be viewed as redundant and unnecessary. He added that when review takes place late in the process, the reviewers are more likely to be seen as advocates, since they will be viewed as either for or against the plan. Earlier consultations, on the other hand, are less likely to be seen as biased. Less bias will be perceived by the public if scientists are helping to build a plan than if they are simply judging its adequacy. It is not really peer review at this stage - more a consultation.

Hannan stated that the stage is set for the scientific community to perform a real service for the USFWS regarding peer review. The Secretary of the Interior and the Services are enthusiastically in favor of peer review; its usefulness is not in question. The Secretary has committed the Services to peer review of ESA actions since 1994. But how has it been performed in the past, and how might it be made better? When in the process should it occur, and how would it be integrated into the legal structure governing the process? (FACA and APA need to be considered) How would it occur, would it be targeted or blind, and how would discordant views be handled?

Kelly pointed out that in any peer review situation, there are always discordant opinions returned by the reviewers; this is not normally a problem in academic situations. However, *Hannan* reminded the *Group* that agency actions have serious economic consequences, and that reviews of management decisions or plans must therefore be viewed in a different light from reviews of publications. Timeliness becomes a more important consideration, as does the fact that it is impossible to guarantee impartiality. He pointed out that the Service sent out listings for external review but often they got none back, and he added that it may be important to pay scientists for the review. Up to now they had asked for them on a gratis basis. More review would presumably result in more accurate results, and could be one way of dealing with potential bias. *Lichti* noted that a team of reviewers, operating as the PL Panel does, could produce a consensus opinion, avoiding situations where reviewers differ. Other models for handling disagreements have been used (e.g. Oregon Department of Forestry).

Courtney suggested several methods for standardizing reviews, including checklists of evidence, as were used in the NCEAS/AIBS study, training of reviewers, which would be necessary to familiarize them with differences between academic and applied reviews, and an articulation of a scientific process of peer review, a guideline statement.

Kelly distinguished between peer review, which would occur near the end of the process, and the involvement of independent scientists in the formation of HCPs. He is personally more concerned with peer review at the draft HCP stage and later, and suggested that the services hire a team of academic scientists on IPA, retaining them for one year, and contracting them to review HCPs and assist the Services in deciding whether or not to approve them. This would dispense with the time crunch problem, since they would have no other duties during this time. It would also be relatively inexpensive. He felt that peer reviewers should be paid and under contract, this way there was a clear commitment and some come back when reviewers failed to deliver. He also pointed out that HCPs should contain all of the relevant information and data upon which management prescriptions were based, so that reviewers could see it.

Pulliam noted that *Kelly*'s description did not constitute his (*Pulliam*'s) definition of peer review, which consisted of independent external reviewers who had not been involved in the plan development commenting on the draft.

Hannan reiterated that the Administration is positive about peer review, but that he could make no promises as to what might happen in a year and a half. He gave the *Group* one year to come up with a concrete proposal.

Brosnan noted that the scientific and agency communities were on board and she broadened the challenge, asking to hear from the private sector and others.

Bullock pointed out that applicants would want to use experienced reviewers and ensure that impartial did not mean uninformed. In particular he expressed concern (echoed by others) that the professional societies (who have performed reviews in other circumstances) are not experienced with applied issues such as HCPs. Reviewers need to be adequately experienced in how HCPs work, as well as with the systems that are to be managed. Those in charge of the review process need to be similarly experienced with HCPs. He echoed the distinction between process input and review and asked whether reviewers, having given their approval to an HCP, would be willing to support it in court and in public. He pointed out that conservation planning is not just science, but is a melding of science and art. *Frisch* agreed with him, and added that there were also management considerations in HCP formation, and considerable internal tension may exist between company biologists and foresters. *Courtney* supported *Bullock's* points about reviewers (and those in charge of reviews) having to be experienced with HCPs; training (e.g. through workshops) might be a useful component of a national peer review system. He supported the idea of a new structure, rather than working through a disparate group of

societies. *Pulliam* noted that scientists could not be asked to comment on the plan, but would be likely to support the science and use of science in the plan, especially if it has passed scientific review and the science was seen to be credible. He distinguished between review of adequacy of science in the plan and review of the actual plan. The former was appropriate to ask of scientist whereas the latter was not.

Tamaribuchi said that all parties must choose and agree to the reviewers.

Courtney explained the Pacific Lumber review process. He convened a panel to decide what information and analyses were needed before planning started. The panel was selected (and paid) by SEI, but were approved by the agencies and the company. The panel evaluated data, suggested what other scientific actions needed to be performed, and who the company should consult, but was never asked to make management decisions. The panel did act as arbitrators on technical matters under dispute, and made clear recommendations on interpretation. This considerably improved the HCP and smoothed the negotiating process with regard to marbled murrelets and spotted owls, which the panel covered. *Gaither* pointed out that the lack of panel involvement in coho planning resulted in position based negotiations and considerable friction between the company and the agencies. Although the panel process cost in excess of $100,000, this was probably well worth the increased efficiency it brought to the negotiations.

Pulliam elaborated on the difference between academic and management-oriented reviews. He noted that a scientist could consider two different papers which reach opposite conclusions on the same subject, and recommend *both* for publication. The reviewer is looking at the quality of the science, not simply 'which one is right.' However, in a management situation, a decision must be made between alternatives. Here the reviewer should consider the scientific support for alternative positions and evaluate the relative strengths and risks of the different approaches. These opinions must then be communicated to the decision-makers in useful form. Reviewing the adequacy of the science used in an HCP and reviewing the HCP itself are two very different things. While it is appropriate that scientists examine the adequacy of science, it might not be appropriate for them to comment on the adequacy of species protections, management prescriptions, etc.

At this point *Hannan* amended his challenge to academia, asking that any proposal be ground truthed with the people who will actually be affected (including critics).

Kelly agreed about the distinction between scientific reviews and commentary on discussions. The IPA team, when first suggested several years ago, would have functioned in an advisory role, but would now assume that a plans formers had had scientific input and would simply review draft HCPs and comment on their scientific content.

Pulliam, *Courtney*, and *Brosnan* stated that whatever structure is formed to handle peer review, it must equally serve all constituents and have be subject to the ownership and confidence of all parties.

Gaither stated that science advising is much more important than peer review, in terms of producing successful plans. *Hood* argued that the peer review/scientific input process can help resolve conflict over HCPs, but that the liaison between the applicant and independent scientists has a major role and responsibility in protecting their independence.

Hood observed that environmental groups who disagree with HCP provisions are still likely to sue over their issuance. *Cullinan* felt that good science would reduce the number of people discontented with a given HCP, as well as the process in general, but he felt that *Kelly*'s proposed team would be tainted by its association with the Services. *Kelly* argued that the team was necessary in order to lend credibility to the decision process.

Green discussed a process which the Forest Service is developing, which includes both scientific input and independent review of both the input and the interpretations of that input which leads to decisions. The reviewers are chosen by the Service, and *Pulliam* wondered if the process would be accepted if they were chosen by outsiders. *Brosnan* noted how in fact they were not accepted as independent by outside groups and she described how letters from external scientists criticized the USFS for its poor use of science and the poor quality of the plan.

Green and *Hannan* suggested two forms of funding: a process similar to EPA Grant Program for clean water research and a HCP Development Fund. The Lands Legacy funding might allows states to apply for money to set up panels.

Hannan asked whether the *Group* felt that having a conservation strategy in place at the time of listing would help applicants. The *Group* strongly endorsed this idea, which would provide clear guidance on the goals of the agencies. This would reduce ambiguity, and increase the effectiveness of science planning. It would materially improve conservation.

Cullinan took the point further and argued that no HCP should be developed for a species without some conservation strategy in place.

The *Group* also discussed planning from an ecosystem objectives perspective, rather than simply on a species by species basis. There was agreement that, where possible, the goal of a HCP should focus on the support of threatened and endangered species, through maintenance of a healthy ecosystem. This ecosystem focus is preferable to the single species approach in most cases.

Tamaribuchi said that many applicants were committed to doing what was right, and genuinely cared about conserving species and habitats. Companies had to worry about the bottom line, but were committed to putting significant resources into habitat and species protection. He pointed out that the Irvine company had spend large sums of money and effort in developing a science based plans, and were continuing their commitment through the implementation phase. *Frisch* echoed these comments.

Tamaribuchi said that involving a scientific panel had saved the company considerable amounts of time and money. The agencies were more likely to find independent scientists credible.

Tamaribuchi and *Frisch* said that they only wanted to use the best scientists and the best science. They were adamant about not using scientists who were not considered the best in their field.

Bullock said there was a need for scientists to identify a conservation strategy for listed species and how HCPs fitted in with this. This type of scientific input can help applicants.

Courtney noted that there was unanimous support for the incorporation of better science, and, where appropriate, peer review. He then asked if the group was ready to move forward with SEI in developing the structure and framework to make it happen. There was already support from USFWS. He challenged industry and environmental groups: would they be willing to engage, support, and come up with resources? An immediate task would be to identify a core group of interested parties who would cooperate and decide on the appropriate framework for peer review, etc.

Frisch responded yes, that she strongly supported the use of science in HCPs. She felt that there were a number of issues that need to be resolved regarding peer review (e.g. who pays, what format, voluntary use by applicant, what group coordinates reviews, what happens when conflicting opinions arise, etc.). She would report the *Group's* findings to AF&PA, and would be interested in working with the next stage (such as a committee on implementation). *Hood* replied yes, that DoW strongly supported peer review and the use of science, and she would be ready to advocate and help.

In response to Hannan's challenge about why applicants should engage with independent scientists, the following list was developed by the Group *later in the day, but applies here. It suggests several possible benefits which scientific input and review might bestow upon permit applicants:*

1. Reduced likelihood of being sued. *Brosnan* illustrated with a case in which an environmental group decided not to sue after peer review approved the science in a plan.
2. Provides scientific arbitration, and saves time and money during negotiations.
3. Enables applicant to "do the right thing" and minimize the risk to the species
4. Added public credibility for the HCP
5. Opens up lines of communication between industry, private landowners, and academia
6. Reduces fear and mistrust of industry within the scientific community.
7. Public confidence in end product
8. Greater assurances that biological goals will be met.
9. Companies want to do the right thing
10 . Continuity

Courtney outlined some of the items that the *Group* had identified for further discussion and decision.

1. What to do with our conclusions. The minutes will be distributed within a week. *Brosnan* will take the lead in writing up the discussions in a format suitable for dissemination or publication.

2. Peer review and Involvement of independent scientists
The *Group* agreed that we should move forward on this item. SEI will coordinate a group (including those present) who will develop the new infrastructure for such involvement. The group will identify strategies for dealing with issues of impartiality, training, funding, etc.

3. Production of a document on 'how to make a good HCP'
The *Group* agreed that this would have value; however it should not be seen as an advocacy document, but as a roadmap for applicants who want to do a good job. SEI will discuss with the various parties whether they wish to participate in production of such a document.

4. Biological goals
The *Group* recommended that scientists engage with the USFWS and help in the delineation of biological goals, generally, and at the species level. Scientists need to play a role in large scale analysis of species and conservation efforts, and "conservation blueprints," or master plans, should be developed as early as during the listing process in order to guide the biological goals and objectives of HCPs and, ideally, to create closer links between HCPs and recovery. USFWS will seek help when appropriate, but proactive involvement of the scientific community in this process would be highly desirable.

5. Monitoring
The *Group* recommended that scientists provide guidance to the Services on setting general monitoring standards and objectives. This might include explicit statistical treatment of, for instance, Type II errors, and the appropriate level of confidence for making decisions under the precautionary principle. The professional societies might help here.

6.Uncertainty and risk
There was extensive discussion of dealing with risk and uncertainty. *Hannan* noted that, procedurally, it is important to keep a complete administrative record that acknowledges risks, and how these are assessed and dealt with. Decision-makers (agency and applicant) will make the call, but scientists need to provide clear statements where possible *Hood* noted that there was an urgent need for HCPs to articulate information gaps. These should not be seen as liabilities, or targets for litigation, but as real needs, which have to be dealt with. The precautionary principle, adaptive management, and well-designed monitoring can all be appropriate ways of dealing with uncertainty.

Population Viability Analyses are favored by some, but are not always useful in resolving problems. Sometimes PVA is most useful in telling you what you don't know (this can guide decision-makers, and help identify where additional research is necessary). PVA is not a blanket solution, and decision-makers should be aware of its limitations.

Gaither noted that most of the tools for dealing with uncertainty were already available. However they were brought piecemeal to HCPs, depending on the experience of those preparing the plans. We need a more consistent approach, which might be fostered by a 'guidance document'. *Green* noted that sometimes the best way to deal with uncertainty is 'best professional judgement'. The *Group* agreed that this is correct, and defensible, but needs to be documented when used. *Gaither* and *Hannan* discussed the Handbook, which gives relatively little guidance on uncertainty; the 5 point policy is more useful.

Hannan asked the *Group* whether an explicit treatment of uncertainty should be a part of any HCP. The *Group* recommended that it should be.

7. Further analyses
The *Group* noted that the AIBS/NCEAS study could be taken further, with additional work on, for instance, the context of the individual HCPs (is good science correlated with a good HCP?), how uncertainty was dealt with, the adequacy of peer review, etc. There might be value in including other conservation plans (e.g. federal plans) in the analysis, to deter

mine whether HCPs fare well or poorly in comparative terms. The existing study group members were encouraged to pursue these lines, which would make the study results more useful to managers.

Monitoring 4/28/99

Wilhere opened the discussion of monitoring by mentioning that monitoring and sampling must be related to objectives. Monitoring is a key component in adaptive management. *Brosnan* added that the first step in monitoring is to define goals.

Courtney distinguished between Type I (falsely finding something which is not actually there) and Type II (failing to find something that is there) errors, and noted that they have received no explicit treatment in the literature related to monitoring. Type II error has been especially widely neglected, and no one has made a careful investigation of their effects on risk assessment. In any sampling procedure, there will be error associated with measurements. If a population trigger for adaptive management has been set at a particular level, statistical error may result in unanticipated real-world problems. For instance, the species' actual population may be higher than indicated by monitoring (Type II), resulting in additional restrictions and economic hardship for the permit holder when this is not necessary. Alternatively, the population could be lower than estimated, allowing the population to dip below the trigger without invoking changes in management, and potentially resulting in extinction.

While increased sampling effort will reduce the extent of error in the measurements, there is a point at which added sampling becomes prohibitively expensive. Therefore, planners are faced with a tradeoff between the cost of monitoring and the accuracy of results. In order to be effective, monitoring programs often require sophisticated statistical designs, which should be stated upfront. Unfortunately, such designs are rarely present in HCPs; in fact, many of the statistical problems involved in designing good monitoring programs have never been worked out by statisticians.

Wilhere added that because decision makers must decide how comfortable they are with the level of risk associated with a given plan, they need to know how certain the assessment of that risk is.

Tamaribuchi asked whether sampling error would pose a larger problem for endangered species than for threatened species, and *Courtney* and *Brosnan* responded that the risk associated with a error would be greater, because the consequences of being wrong would be more severe for endangered species with very small populations. *Courtney* added that because the numbers were smaller, there would necessarily always be a large error associated with sampling.

Tamaribuchi described the network of sampling stations which the NCCP/HCP non-profit uses to monitor habitat and species, including gnatcatchers, and *Courtney* commented that in such a design, sampling error may prevent changes in the population from being detected, since less sampling leads to larger errors. *Erckmann* responded that generating accurate population estimates is often extremely expensive in terms of both manpower and funding, and is not practicable in all cases.

Tamaribuchi then asked how important population monitoring actually was in some cases, taking into consideration the fact that an HCP may occupy a very small and/or marginal portion of a species range, and that populations may fluctuate for reasons beyond the permitee's control. As illustration, he explained that in the Irvine Company's NCCP, habitat amount, rather than gnatcatcher numbers, is the performance standard in the HCP because gnatcatcher numbers are known to oscillate, and the company did not want to be tied to maintaining a certain number of birds when the population might drop below that level because of natural circumstances.

Wilhere replied that the HCP should monitor for its objectives. If maintaining a certain population level is not among them, there is no reason to perform population monitoring. *Erckmann* added that, ideally, planners should pick objectives and performance criteria which are under their control, such as habitat or reproductive success within the covered area. *Frisch* offered the Simpson Timber HCP, which will double the amount of spotted owl habitat on Simpson's lands over its thirty year duration, as an example. *Courtney* suggested that in some cases, a statistical control, such as adjacent

parkland, may be available to distinguish the effects of the permitee's actions from natural variation, but *Wilhere* and *Erckmann* countered that these are almost always quasi-controls and that there exists no proof of causality.

Brosnan felt that it was important to explicitly state what was being monitored, why it was being monitored, and the quantitative goals of the monitoring program. HCPs often state fuzzy goals for monitoring, such as ensuring that the species is 'okay.' Only after the monitoring program has been implemented do planners realize that the probability of detecting whether the species is increasing or decreasing is close to zero. Quantitative goals should be set, and the monitoring program designed to detect them.

Erckmann commented that population monitoring might be further complicated by the fact that many species require different monitoring techniques for each habitat type. *Courtney* agreed that in some cases it may be more advisable to monitor habitat. *Erckmann* and *Tamaribuchi* added that ongoing research can also help to inform a monitoring program. *Wilhere* referred to this as a tiered approach to monitoring. Habitat is monitored, and research is undertaken in order to determine the species' exact habitat needs and the extent to which various habitat patches are occupied. He and *Brosnan* cautioned that since habitat needs and occupancy are often unknown, habitat monitoring alone may not be sufficient to ensure the species' conservation.

Brosnan wondered whether this suggested that the burden of supporting basic research was being placed on permit applicants, but *Wilhere* explained that it was simply an alternative approach to monitoring. The planners could choose to perform population monitoring, but it is expensive and frequently not effective. Alternatively, monitoring vegetation types and experimentally establishing the relationship between habitat and species occurrence would allow planners to estimate density in various patches and therefore the population as a whole. *Brosnan* questioned whether this approach would assume that all available habitat was occupied, and *Wilhere* responded this was unnecessary. Occupation could be determined by periodic research.

Tamaribuchi reiterated the Irvine Company's reasons for using habitat as its performance standard: bird numbers fluctuate naturally and are not in the company's control. At extremely high densities, gnatcatchers have been found to nest in non-habitat. In addition to monitoring habitat, the company voluntarily undertakes research to monitor ecosystem health, bird numbers, and gnatcatcher behavior, because its technical advisory committee suggested this, and the funding was available. However, population and ecosystem monitoring extend beyond the terms of the HCP, which simply requires that a monitoring plan be implemented. *Hood* outlined an alternative scenario, the San Diego Multispecies HCP, in which permits are given to each individual municipality in the area, as well as the county. The HCP says only that they will implement monitoring programs within a couple years of the plan's approval. In the worst case, each permitee would approach this independently, without coordination. Currently, scientists attempting to coordinate the monitoring effort have no idea how much funding will be available, or where it will come from, and can therefore not plan a meaningful monitoring program.

Courtney commented that he had also seen the agencies set adaptive management triggers without considering the costs involved in detecting them.

Courtney and *Wilhere* suggested that since, in many cases, monitoring programs are not equal to the task of informing adaptive management, and many HCPs don't contain provisions for changing management prescriptions in the first place, perhaps it would be more advantageous to use monitoring funds to buy reserve land, especially if a reasonable basis for a trigger cannot be found or if it is not statistically possibly to detect the trigger. If meaningful monitoring can be accomplished, then biologists need to spend more time as a profession thinking about appropriate standards and experimental designs, especially since monitoring programs will almost always violate our standard assumptions.

Kelly agreed that statistical designs are a very important consideration, as is the appropriateness of the choice of habitat or species monitored, the use of indicator species, etc. *Erckmann* commented that the appropriateness of different monitoring standards and techniques depends upon the system of concern.

Kelly pointed out that half of the HCPs studied in the AIBS/NCEAS study did not contain monitoring programs, and that this constituted a problem. He asserted that, at least for large scale HCPs, it should be possible to design a reasonable monitoring program through careful scientific analysis. *Frisch* pointed out that the study included both large and small scale plans, and *Erckmann* elaborated that small plans may not require extensive monitoring. *Kelly* acknowledged their points and reiterated that with a suite of indicators and carefully designed experiment with many samples, it should be possible to design a program.

Courtney agreed, provided that it is possible to obtain a sufficient sample size. However, given the sampling effort required to detect changes near the threshold of a population trigger, programs are often unequal to the task. If they cannot detect the changes necessary to trigger adaptive management, why bother monitoring?

Kelly, *Hannan*, and *Pulliam* disagreed, saying that monitoring was necessary in order to see if management prescriptions accomplished their goals, and that that there was a legal requirement to include monitoring in HCPs. Even if the current HCP could not be changed, the information could be used to plan adjacent or future HCPs. *Courtney* and *Pulliam* agreed that this constituted adaptive management, but on a larger scale than the single HCP.

Pulliam noted that the sampling error problem could be dealt with by including an explicit description of the sampling technique to be used in the statement of the trigger. This would then incorporate the error involved in monitoring into the equation governing adaptive management. Using specific method *x*, for time *t*, if the results drop below *y*, the trigger has been reached. *Lichti* agreed that this would solve the problem, but would require a large amount of baseline data to be present *before* the sampling technique was planned, so that the degree of error was known. In the absence of such information, standardization of monitoring techniques and wide availability of monitoring data from other areas might allow an approximation, freeing the applicant from the requirement to amass years of baseline data before undertaking permitted activities. Once they produced their own data, they could then adapt the program to their specific statistical circumstances. *Courtney* agreed to *Pulliam*'s position, stating that monitoring programs should be designed upfront with scientists and statisticians, in order to assure statistical robustness.

Erckmann pointed out that in some cases, planners may not even know what indices or habitats are appropriate indicators for a species.

Brosnan added that in many cases, HCPs (especially small ones) may be monitoring at a spatial scale which is too small to be meaningful. They may also be adjacent to larger holdings, such as Forest Service lands, which already have established monitoring programs. She wondered whether, in such situations, it would be possible to incorporate the HCPs into existing monitoring programs. *Courtney* responded that marbled murrelet monitoring takes place at sea, and plans conform to an established protocol.

Tamaribuchi suggested that monitoring the entire population, rather than just those animals covered by a given HCP, makes more sense if population monitoring is going to occur. The state of a given HCP's animals might have little effect on the population as a whole. There was general agreement with this position.

Pulliam outlined three different approaches to monitoring, all three of which included habitat monitoring. In the first, which he deemed not to work, but which characterizes the current situation, populations are monitored permit by permit, with no over-arching program or coordination. Each permitee determines their own methods, ensuring that data from different holdings are generally incompatible. In the second, monitoring occurs plan by plan, but with the advantage of a standardized, uniform protocol, as is the case with the marbled murrelet. The third approach requires permit holders to monitor only habitat, while the government monitors populations throughout the animal's range.

Kelly pointed out that even baseline monitoring is rarely done, and that a core problem is that monitoring is frequently put off, underfunded, and otherwise neglected.

Wilhere suggested that these problems result from the lack of incentives for good monitoring. When a deal is struck on an HCP, it is, by definition, a deal which the applicant likes, and monitoring represents a significant economic investment and could result in more restrictions. If monitoring could provide a way to allow more development, permitees might view it as a more reasonable investment. *Courtney* carried this concept even further, asserting that, in fact, there is a disincentive to producing good monitoring programs, because if a change cannot be detected, then additional management restrictions will not come into play.

Tamaribuchi disagreed, stating that if a permitee can demonstrate strong conservation measures, they are in a much stronger position to defend their plan. This is the reason that the Irvine Company is willing to invest heavily in monitoring. *Wilhere* commented that WADNR did not see things this way. *Courtney* and *Hood* noted that many HCPs state that "monitoring protocols will be determined at some future point," and *Brosnan* asked whether the private sector and agencies may have different attitudes toward monitoring.

Kelly suggested that the *Group* make a recommendation emphasizing the importance of monitoring in resource manage

ment in general (not just HCPs), adding that the NSF has spent millions of dollars on long term ecological research, yet monitoring plans, which could provide an abundance of extremely valuable data, are allowed to slip through the cracks.

Erckmann noted that there seems to be a national philosophy of dealing with ecological issues as a battle for approval. Once the fight is settled and action has been taken, people walk away and no one does any follow-up assessments. However, he asserted, there must be some way of determining plans' effectiveness; because they are long term operating agreements, we cannot afford to simply walk away from them. *Frisch* responded by noting that reporting requirements and performance evaluations do exist, but *Courtney* commented that, while the Simpson HCP contains these provisions, this is not necessarily true of all plans. *Erckmann* agreed that Simpson might be an exception to the rule, emphasizing that many permitees face serious problems in trying to produce meaningful monitoring programs.

Courtney's suggestion to use monitoring money to buy lands was briefly revisited, and *Gaither* noted that The Nature Conservancy is investigating whether it might make better use of its funds by dedicating them to land acquisition rather than monitoring its Californian reserves.

Kelly and *Courtney* suggested that the *Group's* recommendations emphasize the importance of a well designed, meaningful monitoring program. This was accepted. A poorly designed monitoring plan, with no clear goals, is simply a waste of valuable resources.

The *Group* also recommended that the regulatory agencies provide leadership in identifying how to proceed with monitoring at larger scales. Small-scale efforts (e.g. at the HCP level) should be guided by, and integrated into, a larger program, rather than being so idiosyncratic as to provide little useful information at larger scales.

Returning to the discussion of the appropriateness of monitoring, *Erckmann* noted that there are two general strategies available for handling biological uncertainty, once it has been recognized and acknowledged; managers can either monitor the species of concern and make provisions to adjust their management prescriptions as appropriate, or they can build in a safety net by setting aside reserves or buying more land. These approaches are not mutually exclusive, but *Kelly* noted that one may be more appropriate in some circumstances than the other. For instance, in the case of some endangered species, only relying on a safety net may carry significant risks.

Tamaribuchi added that he anticipated a decline in monitoring costs over the life of the Irvine Company's HCP, as regulators and the company become more comfortable with the status of areas which are currently under intense scrutiny.

Green added that the forest service is currently in court over monitoring, and that while habitat must be monitored, plans may not rely on habitat monitoring alone, but must make use of population monitoring as well. The degree to which populations must be monitored depends upon the scale of management activities and the degree of risk involved. She cautioned that most habitat models, even for well studied large game species, are very rough, and although they may be combined with several other rough indices to produce a comfortable indication of status in moderate risk situations, higher risk species (i.e. threatened and endangered) may require a heavy investment in statistical sampling and sophisticated monitoring plans. She also cautioned against the use of indicators as proxies for other species, unless very clear, tight relationships were known to exist between the two. *Brosnan* added that in some communities, such as marine systems, populations can change dramatically without any apparent alteration of the habitat.

Closing Remarks 4/28/99

Pulliam felt that the meeting had been more than useful. The consensus in this meeting was that the 'HCP glass is half full'. We carry the burden of making sure that this good message is carried forward, and that positive changes are implemented. He identified the three workshop topics as fruitful action areas:

Scientific involvement and peer review: there is more than one way for a scientist to get involved in the HCP process, and all of them should be encouraged. We are charged with developing new structures to make this involvement more systematic and productive.

Adaptive management: The key to many problems. Clearly there is some tension between this scientific process, and the no surprises policy. However they are compatible. The issue now is how to develop processes to make both work most effectively (such as putting sidelines, and explicit triggers and expectations).

Monitoring: This may occur at different scales to adaptive management. There is no sense in uncoordinated individual plans, and a clear need for the agencies to have a common standard.

Brosnan closed the workshop with thanks to all those who had attended, organized, funded and supported the meeting. She pointed out the considerable achievements of the meeting, and looked forward to the *Group* continuing to work together, to implement our recommendations.