TO: **SAM Work Group and MRRIC**

FROM: **Independent Science Advisory Panel (ISAP)**

RE: **Response to 6 December 2012 presentation and questions (dated 3 December 2012) from the SAM Work Group and MRRIC**

DATE: **23 January 2012**

The Independent Scientific Advisory Panel (ISAP) appreciates the opportunity to review and consider ongoing efforts to inform the Missouri River Recovery Program. The ISAP acknowledges the substantive effort by a number of agency staff biologists to prepare and present materials related to the conceptual model for the pallid sturgeon, and the support framework for its application in adaptive management during a "webinar" on 6 December 2012 that was attended by the ISAP and other interested parties from the resources agencies and the Missouri River Recovery Implementation Committee.

The ISAP followed the webinar with a conference call on 12 December 2012 to discuss the material presented, and how to respond to seven questions concerning the material presented posed to the panel by the SAM working group. While the ISAP offers brief responses to each of the seven questions here, the ISAP also includes more general comments about conceptual models. The ISAP notes that the post hoc assessment of the substantial work that was presented in the webinar and the formal written question and answer format seems at least inefficient. Had many of the more substantive comments and suggestions offered here been considered early in the design and construction of the pallid sturgeon conceptual model, progress toward a river operations and management scheme that meet the intentions of the biological opinion regarding Gavins Point Dam and the three listed species would most likely be further advanced. Accordingly, the ISAP suggests in the close of this memo-report a process description for this and future engagements that can make the review of these and similar efforts both more rewarding and timely.

Because the webinar presentation focused on the development of a conceptual ecological model (CEM) that is expected to support an analysis of the effects of river operations on the three listed species, which in turn will determine a management regime and environmental restoration actions in an adaptive management program, the ISAP believes it is useful to describe the role of conceptual models in that sequence of activities. That view provides the background for the ISAP answers to the questions posed by the SAM. Here the ISAP offers some observations about conceptual models and their role in conservation planning in general and implementation of the federal Endangered Species Act.

Conceptual models in conservation planning

Conceptual ecological models can be useful in guiding conservation-planning efforts, the development of assessment and monitoring programs, the design of research agendas, and serve as a fundamental step in the implementation of an effective adaptive management program. However, the most immediate practical application of conceptual models in planning for the Missouri River is as the initial step in identifying the specific management actions that are necessary to reduce the jeopardy to the listed species that is caused by resource uses that result in take of those species (prohibited under the federal Endangered Species Act). One or more conceptual models that link a listed species to the environmental attributes of its habitats, and the environmental stressors that affect it and its habitats, can be essential to an assessment of whether a resource management action "jeopardizes the continued existence" of that species, and to the identification of mitigation activities that might reduce that jeopardy.

Conceptual ecological models document a specific version of the hypotheses about how ecological systems function. They describe in graphical or narrative form the essential ecological attributes of species of conservation concern and the ecological systems that support them. Conceptual ecological models thus allow inferences about how a species and the ecosystems in which it is embedded "work" – the essential first step in managing a species. Conceptual ecological models help to clarify our verbal descriptions of what we have observed in nature, enabling us to visualize and think about ecosystem elements and interactions that we might otherwise ignore. The construction of CEMs forces one to organize empirical information in ways that facilitate the next steps in the management actions. In developing conceptual models, it is expected that the experts involved will have access to all pertinent knowledge of the species, including observations, data, analyses, models, reports, and published material, and will draw from that information base the "best available scientific" information. That reliable information will be used in the steps leading to the agency's determination of the effects of a management action being considered, the appropriate management responses to those effects as Reasonable and Prudent Alternatives (RPAs) in a Biological Opinion or other agency determination, and then the adaptive management program in which conservation actions are implemented.

To ensure that a CEM contributes to the identification of the environmental factors that need to be targeted by resource managers (and subsequently measured in a well-designed monitoring scheme), the CEM should be structured to incorporate explicitly the environmental factors that are affected by ongoing resource management and illustrate how those management activities impact target species and their habitats. Formulating conceptual models allows us to rank the importance of different environmental attributes in determining the status of species and the habitats that support them. Conceptual models help one ensure that management actions target the correct ecosystem features and functions, and maximize the likelihood that the management actions will produce the desired outcomes.

A conceptual model that focuses on a listed species should clearly identify key system elements, including the species, the structure of the ecosystem that supports it, and linkages between the species and other biotic and physical elements in the system. The model needs to describe how the system is or may be impacted by environmental stressors (disturbances, perturbations) from both natural and human-generated sources, and how management can intervene to reverse undesirable conditions or trends. Whatever the form of the conceptual ecological model, its purpose is to convey reliable knowledge about the species of concern, the ecological community in which it is embedded, and the ecosystem factors or processes that support it or put it at risk.

Because a full understanding how the Missouri River's ecosystems operate is far into the future, uncertainties about the system abound, and the CEMs are surely going to be incomplete and incorrect in some aspects. These shortcomings will be addressed as new information becomes available. If the adaptive management effort is effective, the CEMs under construction now will improve as one learns while managing. Conceptual ecological models are essential to learning, in that they make our understanding of how our natural systems work available for explicit discussion and revision, thus helping us identify areas of uncertainty. The CEMs for the listed species on and in the Missouri River serve as gateway deliverables on the path to developing predictive operational models. When those operational models are constructed, one will be better positioned to evaluate the relative benefits (and costs) of available management options for the pallid sturgeon, piping plover, and least tern, and then rank the conservation opportunities in a defensible decision-support framework.

The CEMs for the three listed species on and in the lower Missouri River, therefore, have a highly specific immediate application. The CEMs need to organize and convey available knowledge regarding the ecology and behavior of the fish and two birds, and describe what is known and presumed about their responses to environmental stressors, particularly stressors that are presumed to jeopardize them. Conceptual ecological models need to be as ecologically inclusive as practicable, but in their immediate application in support of an effects analysis they must provide insights into key linkages between the target species and the operations and management actions that affect the targeted species. They also serve to organize that knowledge to make it available for purposes of ranking threats to the species and prioritizing management actions drawn from conservation options that are expected to mitigate those threats. Thus, identifying and assembling the best available scientific information in the process of building the CEM is the initial step in undertaking the effects analyses for listed species. The CEM is considered "complete" when experts agree that its structure accurately conveys essential relationships using reliable information for the species and their habitats, and appropriately acknowledges the uncertainties that accompany those relationships. Accordingly, the CEM step in carrying out an effects analysis is not a

hurdle to be surmounted, but represents the best opportunity to get the "science" straight and ready to be used in next process steps.

Converting a conceptual model into an operational model requires quantification of species responses to (varying) environmental conditions; in so doing, the effort parameterizes elements of the conceptual models to facilitate an analysis of the effects of river operations and mitigation activities on the listed species. That quantification process allows for a population viability analysis (PVA), or some demographic modeling equivalent, to be carried out in order to model the potential impacts of river operations on target species and evaluate the relative effectiveness of alternative management actions. Population viability analysis, a form of risk assessment, estimates the likelihood of the extirpation of a population under varying environmental and management scenarios. On the lower Missouri River, this can include alternative dam operations, and pulse-release scenarios and site-specific efforts to construct the habitat features that may contribute to population persistence and recovery.

Questions and answers

Against this background the ISAP considers the conceptual modeling effort underway that targets the pallid sturgeon. The seven questions below have been posed to the ISAP.

1) *Is the pallid sturgeon CEM (i.e., the combination of the species needs model and the action-based model), and the lead agencies'/MRRIC's vision of its use, consistent with the intent of the MRRIC proposed actions/ISAP's recommendations?*

No. The approach to informing the effects analysis using a "species needs model" steers the conservation planning envisioned for the three species off track. The needs of the species are not the primary focus of the effects analysis and adaptive management to come. Rather, the primary focus is the statutory requirements for permits for river operations and the need for guidance for management and restoration activities to mitigate for impacts on listed species caused by river operations.

In elevating species needs as the goal of the conceptual model, a natural disconnect exists when attempting to link the species needs model to an action-based model. Webinar slide 7 (*Tools Used in Development of AM Plan*) portrays not a natural transition between the "species needs model" and the "action model," but effectively a start-over point in what should actually be a step-down, inter-linked sequence – from CEM development-to-effects analysis-to-identification of operations scenarios and accompanying mitigation and restoration actions-to-implementation of actions in an adaptive management program. The availability of the information in the species needs model facilitates the construction of the conceptual model(s) that are necessary to inform the effects analysis for pallid sturgeon. But a species needs

model is not the appropriate construct from which next-step quantitative models are built to provide the "analysis" framework for the effects analysis. Only a model informed by the effects of river operations, baseline environmental conditions, and potential mitigation actions can do so.

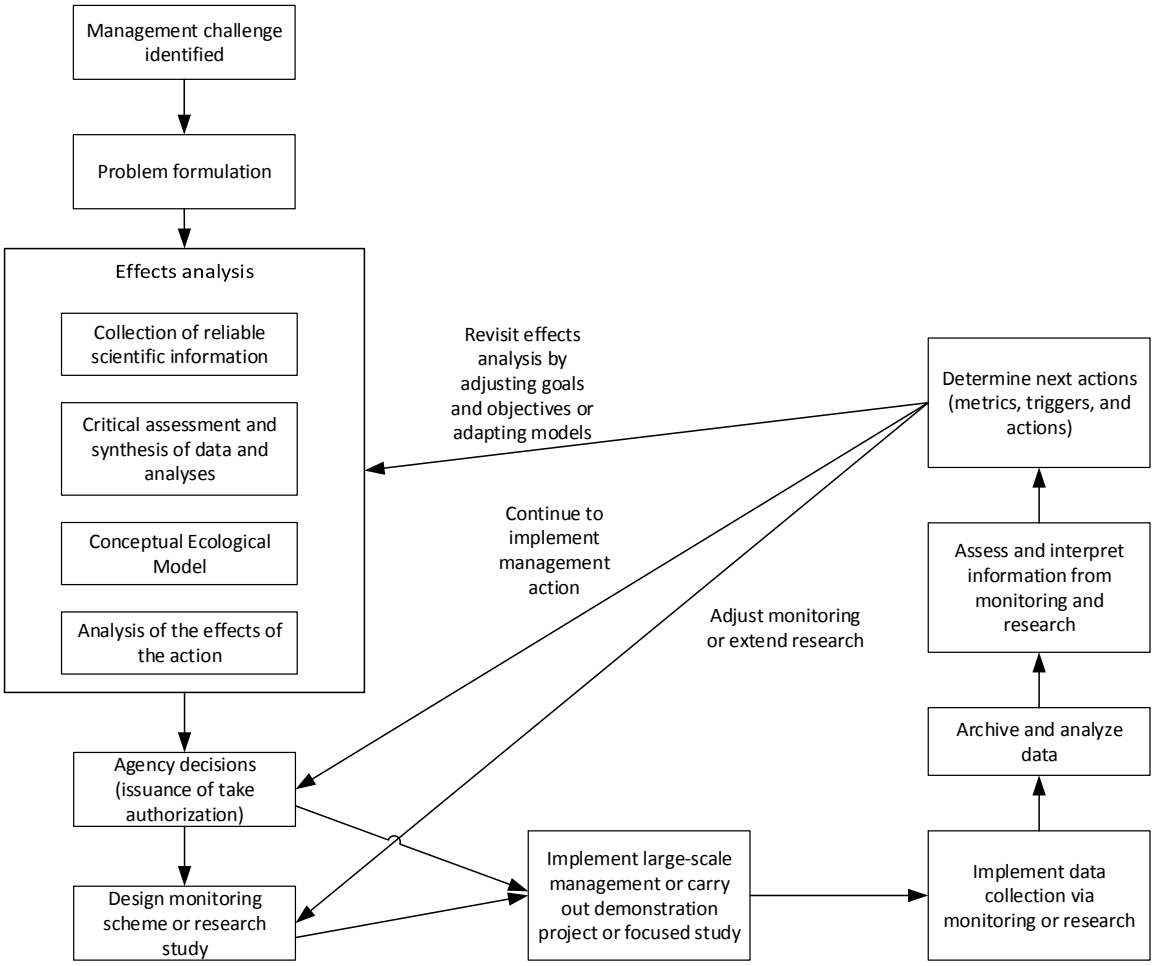
The step down process from CEM(s) to implementation of adaptive management is not well illustrated in webinar slide 7; instead, a process similar to that in the following figure is required (see Figure below).

Importantly, the effects analysis box is reached after a formal process of identifying the management challenge and describing the management problems that are to be addressed in the effects analysis. The conceptual-model development step is carried out solely in service of the effects analysis, with the effects analysis in service of the process of identifying an operations and management scenario that can defensibly serve as the basis for take authorization by the U.S. Fish and Wildlife Service.

2) *Provide your thoughts on the functionality of the pallid sturgeon CEM – how it is set up; does the structure, and the material in it, meet the intention (i.e., articulate the effects of stressors from big actions on species performance)?*

The ISAP believes that the current CEM efforts need to be re-structured to be more instructive in evaluating the effects of river operations and evaluating potential mitigation and restoration actions. The organizational schematic in webinar slide 7 does not reflect the most productive approach to informing effects analysis and is not consistent with the current literature on adaptive management. The proposed approach identifies species limiting factors (or "needs"), and then identifies actions that might be conducted to address those limiting factors (that is, meet the identified needs). That sequence implies that actions will be conducted when better (perhaps near-perfect) knowledge of the factors that limit pallid sturgeon population growth has been met. Such data do not currently exist for any of the listed species on and in the Missouri River. Moreover, while a better understanding of Missouri River ecosystems and the three listed species is desired, restoration actions and species recovery efforts are required now.

A conceptual approach with an alternative sequence in logic and one more consistent with the literature on and practices of adaptive management is required. The ISAP acknowledges that the approach presented in the webinar is not so much wrong, but setting an understanding of "species needs" as the near-term goal in the development of conservation strategies for the listed species is not the most efficient pathway to the implementation of adaptive management on the Missouri River. The focus of the CEM should include hypothesized mechanisms by which river operations and management responses influence the listed species and then, referencing the known ecology and behavior (the needs) of the species (largely



articulated in the available Wildhaber et al. models). Furthermore, the CEM should describe how the species is likely to respond to different operations and management scenarios. In so doing, the conceptual model for pallid sturgeon will meet the recommendation that the identity of "pathways from management actions to performance" be ascertained, as presented in the third of the seven ISAP recommendations on webinar slide 4. (Otherwise, it is not until webinar slides 36 through 41 that one sees approaches that are consistent with that recommendation.)

The pallid sturgeon CEM and its link to the three management actions – pulse management, shallow water habitat creation, and development of emergent shallow habitat – has the seeming unintended effect of setting the stage, not for an analysis of the effects of ongoing river operations and potential mitigation actions that are to follow the development of the CEM, but an analysis just of the current three mitigation actions that have been identified to counter the effects of operations. (That is itself a subsequent step in the effects analysis process that is used to guide

the determination of operations and mitigation responses.) The sequence put forward in slide 34:

> What critical sturgeon needs are not being met?
> What is the cause (stressor)?
> How can we reduce stressor?
> Evaluate actions and combinations of actions?

is not directly equivalent to the sequence:

> What are the impacts of current river operations on the sturgeon?
> What management actions are available to mitigate for those actions?
> What is the preferred alternative or combination of management alternatives that will fulfill obligations to reduce jeopardy?

The latter sequence responds to the information needs required to fulfill the intentions of the biological opinion.

The ISAP wants to reemphasize that the compilation of scientific information on the species to date, along with the developed CEM are necessary on the pathway to adaptive management. However, these elements need to be reorganized, and this reorganization forms the basis for reorganizing the thinking for how management actions and species recovery are related through the adaptive management process.

3) *Can we improve the pallid sturgeon CEM's usefulness as a tool to inform formulation of objectives, management actions, and subsequent models relating management actions to species performance? If so, how?*

The process of predicting the response of species and habitats to various operations scenarios and management actions, and identifying which potential operations-management actions to implement, results from the effects analysis. It is where the operational model (a mathematical form of the CEM) and additional sub-models are used to make predictions of probable conservation outcome scenarios. McGowan (2013) offers an example of how demographic predictions can be drawn from scenario testing – actually using the piping plover in its modeling effort. The McGowan presentation, considered with Smith (2011) and Allen et al. (2011 – references provided below), offer guidance to those constructing conceptual models for pallid sturgeon, piping plover, and least tern. The articles indicate that to get to operations and management scenario testing, CEMs need to fit an overarching decision-support process that incorporates the following steps.

First, the management objectives must be identified and the potential routes to their achievement are agreed upon. Although this may seem like an elementary step because planners should "know" what the overarching problem is, the problem in the context of management actions may not be as clear. This is an essential first step in order to keep the adaptive management process from becoming an uncoordinated monitoring and research program (as can occur in a program driven by species-needs models).

Second, management objectives need to be clearly defined in terms that are measurable. These objectives should relate to the population demographics outlined in the CEM.

Third, management action(s) are selected from among options that address specific population needs in relation to specific aspects of population demographics (for example, survival rates, fecundity, or population growth). Then predictions are made regarding the effects of selected management actions on the measurable attributes of pallid sturgeon population dynamics using quantitative models, which are derived from the CEM.

4) *Does the approach to action-based modeling meet your intent of representing the linkages between management (mitigation) actions, species need model hypotheses, and species performance?*

Not very well – see discussion above and below.

5) *The process of effects analysis is just beginning and it may take some time to complete, concurrently we are in the process of developing the CEMs – as such, how can we most effectively get feedback between the CEMs and the effects analysis?*

Development of a pallid sturgeon conceptual model is an essential first step toward a comprehensive conservation plan for species on the Missouri River; however, the CEM ultimately cannot serve as the functional model for purposes of conducting effects analyses or (ultimately) in implementing an adaptive management program. The CEM is essentially a heuristic tool and a blueprint to guide the development of corresponding operational models that permit the exploration of anticipated population responses as the result of proposed management actions. To move forward, an operational model based on the CEM will be required.

The operational model will be in mathematical form, allowing the incorporation of essential attributes of the system, parameterized to be as realistic as possible. The operational model must include a sturgeon population-demographic component that is dynamic to represent inter-annual variation in demographic rates and longer-term population trends. The model must incorporate stochastic variables associated with river flows and other environmental variables that are influenced by operation of the dams on the system. Fortunately, population demographic models are already available for the pallid sturgeon and can be adapted for use in those efforts. Available data from surveys, monitoring efforts, and directed research on the species and its environment should be critically examined to determine how those data can be used to assist in quantitative model development, model calibration, and evaluation.

An operational model must also incorporate management-action sub-models, which include essential life-stage specific ecological attributes on pallid sturgeon – similar to those presented in the current species-needs models. Development of those sub-

models requires deriving quantitative relationships between potential management actions and the values of demographic (or other model) parameters. The sub-models must be linked to population demographic model components in order to perform an effects analysis, compare proposed management actions, analyze the effectiveness of eliciting a population response, assess risks, and address uncertainties. The ISAP encourages efforts to start with rapid prototype models, and to use the McGowan paper for some guidance. Simplicity in such model development does not imply a lack of intellectual engagement; rather it helps prioritize the information needs and management actions more rapidly and efficiently.

6) *Are there any pitfalls you foresee moving forward and, if so, are there any course corrections needed at this point?*

The ISAP believes that re-crafting the conceptual ecological model(s) in terms of operations impacts and mitigation opportunities is essential for the reasons described above. Other approaches will likely unnecessarily extend the pathway from CEMs to adaptive management and burden the process, or lead it to a dead end.

7) *Building on the "MRRIC Proposed Actions," at what points and/or at what intervals would technical review to assess and/or validate the ongoing implementation efforts to be most useful?*

Changes should be made regarding the ISAP involvement in the several issues ahead, from further development of CEMs for the three listed species to the complex construction of an adaptive management plan for the Missouri River system. The current review of the in-development pallid sturgeon CEM seems belated. Especially given the fundamental misstep that the ISAP has identified – the development of an exhaustive species needs model, when an operations and management-driven conceptual model was called for – which has at least delayed progress to the effects analysis step and then on to the identification of an operations and management scenario and supporting adaptive management program. A lack of time to review the CEM materials prior to the webinar presentation and subsequent panelist scheduling conflicts have contributed to making the review of the webinar and this written response challenging.

The ISAP remains very interested in continuing to provide guidance, advice, and review to MRRIC and the SAM as the CEMs, effects analysis, and adaptive management are developed. With that said, the ISAP believes that MRRIC is best served by the ISAP remaining in a meaningful and independent role. The panel believes that such a role can be realized with a clear, a priori understanding of our future tasks, a better timeline for deliverables, and an opportunity to interact with program staff earlier in product development. The panel should be involved in the framing of the formal questions that it is tasked to consider in order to facilitate

most effectively the transfer of useful information in future review and assessment exercises.

During the 6 December 2012 webinar discussion, it was suggested that more frequent interactions of the webinar sort would reduce the likelihood that program elements might miss their intent or otherwise get off track. The ISAP proposes that the ISAP be available three or four times per year (quarterly), potentially in conjunction with MRRIC meetings, to conduct assessments of in-progress and completed project materials deemed appropriate for review by MRRIC and the SAM, and to discuss technical projects that may be pending. The ISAP will need materials for review at least three or four weeks in advance of face-to-face meetings or webinars that are designed to permit a formal review. The timeline for a written response from the ISAP can be determined during the meeting. There should be flexibility in the timelines for reviews, given that products subject to review and review deliverables from the panel will inevitably vary in scope. The ISAP should be notified if no reviews or other interactions are expected in a pending quarter.

Additional Comments

The ISAP emphasized in the report in 2011 the importance of leveraging data, analyses, and models available from ongoing restoration experiments and monitoring being carried out elsewhere. Fundamental to an effects analysis and an adaptive management plan is incorporation of information that has already been gathered. Over the past decade, numerous studies have been conducted on actions such as spring pulses and the construction of shallow water habitat, and the response of the Missouri River and other river systems to floods and droughts. Each of these actions or events, combined with data from monitoring, represents an important experiment that can contribute to developing an understanding of a listed species and its interaction with potential management actions. There are many ongoing and historic monitoring programs on the Missouri River, some system-wide (surveillance level), and some action-specific. It is unclear to the ISAP how, or if, the data generated have been or will be incorporated into the models now in development. While it is necessary to build from the ground up a synthetic understanding of the species (as is the focus now), it is equally important to understand how the system and the three species have responded to historic and ongoing actions, events, and experiments. This is an important step, and it is absolutely essential that time and thought be given to evaluating the data already available from river operations and management actions already implemented, and from natural events that have occurred. Furthermore, because the CEMs must be action-centric, it is likely that the data from the monitoring programs that accompany ongoing management actions will be more informative in the construction of CEMs than data generated from species-needs-related research.

It is unclear to the ISAP what process was used for developing the CEM that was presented on 6 December 2012. Based on webinar slide 12, the ISAP interpreted the process to include broad engagement with internal personnel and external

experts via workshops – but presumably not experts from outside the basin. If so, the ISAP might ask if the pallid sturgeon CEM represents the a consensus of the lead agencies, an agreement among all of the agency biologists involved, or the consensus of both agency biologists and outside experts? The ISAP believes it is important at this early point in the process that such products and associated documents and presentations convey the level of agreement or disagreement among experts, particularly when there are specific aspects of the conceptual model that may be disputed. As the Missouri River conservation planning process moves forward from CEMs toward a formal adaptive management plan, such agreements and disagreements will represent critical decision points. Through a transparent, structured decision-making process, agreements on the foundational planning problem, planning objectives, and approaches to problem solving can be achieved.

The ISAP notes an apparent lack of interaction between the personnel working on the Missouri River recovery program and those working on similar restoration projects elsewhere. It is unclear to the ISAP how the agencies working on the Missouri River have engaged other restoration programs. In the letter from Dave Ponganis to MRRIC (23 October 2012), Ponganis states "We have communicated with other flow management programs (i.e., Columbia River Fish Mitigation Program) and have added adaptive management expertise (Craig Fischenich, USACE-ERDC) to our support team…" The ISAP is encouraged by this development, but noted that Mr. Fischenich was not a participant on the webinar and conference call; and, the ISAP remains concerned that the level of outreach and engagement with others beyond personnel internal on the Missouri River is limited. There are significant resources within the Corps and the USFWS that can contribute technical support and guidance in the development adaptive management on the Missouri River. The ISAP suspects that if the expertise available elsewhere were sufficiently utilized, there would have been much earlier reorganization of the CEM along the lines of what the ISAP is only now able to recommend.

References

Allen, C. R., J. J. Fontaine, K. L. Pope, and A. S. Garmestani. 2011. Adaptive management for a turbulent future. Journal of Environmental Management 92:1339-1345.

McGowan, C. P. 2013. A structured approach to incidental take decision making. Environmental Management 51:241-250.

Smith, C. B. 2011. Adaptive management on the central Platte River—Science, engineering, and decision analysis to assist in the recovery of four species. Journal of Environmental Management 92:1414-1419.