Cumulative effects modeling for grizzly bears in the Greater Yellowstone Ecosystem
by Beverly Gail Dixon

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University
© Copyright by Beverly Gail Dixon (1997)

Abstract:
The Cumulative Effects Model (CEM) is a computer package designed to facilitate the evaluation of human impacts upon grizzly bear habitat. Although there are various versions of the CEM currently utilized in different geographic locations, this document will deal specifically with the model developed for the Greater Yellowstone Ecosystem (GYE). The purpose of this thesis is to document the development of the GYE CEM; a process which has spanned the time period from 1983 to present. This thesis will address the purpose and need for the CEM, its history and evolution, and the people involved with development of the model. The database upon which the model runs will be described in detail, including discussions of data collection methodologies and database maintenance. An explanation of the conceptual model will be presented, including descriptions of the coefficients and formulas that drive the computer model. Finally, future development needs will be evaluated. The intended audience for this thesis includes resource managers in the GYE, agency biologists and modelers, and interested members of the general public and scientific community.

CUMULATIVE EFFECTS MODELING FOR GRIZZLY BEARS IN THE

GREATER YELLOWSTONE ECOSYSTEM

by

Beverly Gail Dixon

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Fish and Wildlife Management

MONTANA STATE UNIVERSITY — BOZEMAN
Bozeman, Montana

December 1997

ii

APPROVAL

of a thesis submitted by

Beverly Gail Dixon

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

Harold D. Picton

_____
(Signature)

_12/3/97_
Date

Approved for the Department of Biology

Ernest R. Vyse

_____
(Signature)

_12/3/97_
Date

Approved for the College of Graduate Studies

Joseph J. Fedock

_____
(Signature)

_12/4/97_
Date

iii

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a master's

degree at Montana State University - Bozeman, I agree that the Library shall make it

available to borrowers under rules of the Library.

If I have indicated my intention to copyright this thesis by including a copyright

notice page, copying is allowable only for scholarly purposes, consistent with "fair use" as

prescribed in the U.S. Copyright Law. Requests for permission for extended quotation

from or reproduction of this thesis in whole or in parts may be granted only by the

copyright holder.

Signature _Beverly B. Dixon_

Date _December 3, 1997_

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

TABLE OF CONTENTS — <u>Continued</u>

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The Cumulative Effects Model (CEM) is a computer package designed to facilitate the evaluation of human impacts upon grizzly bear habitat. Although there are various versions of the CEM currently utilized in different geographic locations, this document will deal specifically with the model developed for the Greater Yellowstone Ecosystem (GYE). The purpose of this thesis is to document the development of the GYE CEM; a process which has spanned the time period from 1983 to present. This thesis will address the purpose and need for the CEM, its history and evolution, and the people involved with development of the model. The database upon which the model runs will be described in detail, including discussions of data collection methodologies and database maintenance. An explanation of the conceptual model will be presented, including descriptions of the coefficients and formulas that drive the computer model. Finally, future development needs will be evaluated. The intended audience for this thesis includes resource managers in the GYE, agency biologists and modelers, and interested members of the general public and scientific community.

CHAPTER 1

INTRODUCTION

Why Model?

Wildlife managers often must make critical decisions based on limited information. Increasing interest in natural resources has elevated the scrutiny of management decisions by both the general public and the scientific community. Wildlife managers are responsible for extremely complex systems and are held accountable for their decisions. In this situation, the question becomes not whether to model, but how to model information in a way that will be most efficient and useful (Starfield 1997).

A model is basically an abstraction used to represent a process or system. Models are generally designed as analytical tools that help us to understand the mechanisms which drive the processes or systems of interest. They help us to define and understand the problem at hand and to organize our thought processes with regard to the problem as defined. Modeling may allow us to better understand the data that are available and identify additional data required to address the problem. Models may facilitate the simulation of natural processes so that we can make predictions and projections on which to base our management decisions (Starfield and Bleloch 1986).

Simulation is one of the key functions of models. With this property, we can ask "what if..." questions and examine the potential consequences. This capability not only makes modeling more efficient than trial and error, but also allows us to avoid risking potentially devastating effects of our actions. Richard Dawkins (1989) wrote, "No amount of simulation can predict exactly what will happen in reality, but a good simulation is enormously preferable to blind trial and error." Let us turn now to a discussion of one particular natural process simulation model, the Greater Yellowstone Grizzly Bear Cumulative Effects Model.

The term "Cumulative Effects Model" (CEM) as used in this document, generally refers to the computerized modeling technology designed to facilitate the assessment of human impacts upon grizzly bears (*Ursus arctos*) and their habitat. Various versions of a CEM have evolved in different geographic locations. Although these concurrent efforts will be addressed occasionally to provide context, this document will focus primarily on the design, development and use of the CEM and associated database for the Greater Yellowstone Ecosystem (GYE).

The GYE encompasses an area of approximately 6 million acres, primarily of federal lands administered by the United States Forest Service and the National Park Service. The GYE grizzly bear recovery zone includes parts of the Beaverhead, Gallatin, Custer, Shoshone, Bridger-Teton, and Targhee National Forests, as well as Yellowstone and Grand Teton National Parks. (See Figure 1).

Figure 1: GYE Grizzly Bear Recovery Zone with administrative boundaries for the Beaverhead (BNF), Gallatin (GNF), Custer (CNF), Shoshone (SNF), Bridger-Teton (BTNF) and Targhee (TNF) National Forests, Yellowstone (YNP) and Grand Teton (GTNP) National Parks and private (PVT) land.

Purpose and Need

Activities of natural resource management agencies are governed by a suite of laws, regulations and policies. The development of the GYE CEM was initiated at least partly in response to such legal requirements. In the lower 48 United States, the grizzly bear is listed as a threatened species under the Endangered Species Act (ESA 1973). Legislation mandates that the effects of actions and an analysis of any cumulative effects of land uses and management activities be evaluated as part of the biological assessment process for listed species. The National Forest Management Act requires that the US Forest Service maintain sufficient habitat to sustain viable populations of native species (NFMA 1976). The National Environmental Policy Act requires an assessment of the cumulative impacts of human activities upon the environment (NEPA 1969). With respect to grizzly bear habitat modeling, cumulative effects has generally been described as "the combined effect upon a species or its habitat caused by the activity or program at hand, as well as other reasonably foreseeable events which are likely to have similar effects upon that species or its habitat. Cumulative effects can result from individually minor but collectively significant events taking place over a period of time" (USDA 1985).

Historically, analyses of cumulative effects have occurred at the individual project level and have been limited to the immediate project area. The problem with this strategy for assessing the cumulative impacts of human activities on grizzly bears, is that the grizzly is a wide-ranging animal with home ranges that can exceed 965 square miles (Weaver, et al. 1985). Also, the legal mandate for cumulative effects assessment requires

consideration of the potential for collective human activities to produce an adverse effect on survival of a *population*. By this standard, the impacts from individual projects, even including cumulative impacts within the immediate project area, will rarely be determined to produce a negative effect on the entire grizzly bear population. However, if viewed collectively, the accumulation of a multitude of individual projects and activities could threaten the viability of the population (Mattson 1993a). The CEM provides managers with a tool to quantitatively and qualitatively assess human impacts over a broad spatial scale that has biological relevance to the grizzly bear population in the GYE.

Background and History

Early attempts at modeling the effects of human activities on grizzly bear populations were pioneered on the Flathead and Kootenai National Forests in the Selkirk and Cabinet-Yaak ecosystems of northwest Montana in the early 1980s (Christensen and Madel 1982). This process involved mapping human activities on mylar overlays, then using these overlays to position and schedule events so as to minimize the spatial and temporal overlap of human activities within grizzly bear habitat. Although this effort gave us a new perspective for assessing effects of human activities on grizzly bears, the manual manipulation of geographic information on mylar overlays was cumbersome and time consuming (Weaver et al. 1985).

In January 1984 the Yellowstone Ecosystem Grizzly Bear Subcommittee appointed an Ad Hoc Work Group to "define the goals, objectives and scope of work" associated with the cumulative effects assessment process for grizzly bear habitat within

the GYE. Members of this group included Forest Supervisors of the Gallatin, Targhee and Shoshone National Forests, Superintendent of Yellowstone National Park and a representative of the US Fish and Wildlife Service (USDA 1984).

As directed, this work group produced the stated goal of: "Develop methodology to quantitatively and qualitatively assess the cumulative effects of human activity on grizzly bear habitat and bear use of that habitat in the Yellowstone Ecosystem." Objectives were listed as:

1.   Evaluate the current methodology of cumulative impact assessment developed for the Kootenai and Lewis and Clark National Forests.

2.   Develop a habitat component mapping system for the Yellowstone Ecosystem following review of IGBST/NPS data.

3.   Develop a list of assumptions.

4.   Collate, evaluate, and provide criteria of determining the influence zone of human activity, related to bear behavior.

5.   Develop a rating system to qualitatively and quantitatively display relative influences of various human activities.

6.   Determine the quantitative and qualitative thresholds for habitat availability, both spatially and seasonally, that are necessary to meet bear management objectives.

7.   Develop criteria for describing Bear Management Units (USDA 1984).

With goals and objectives established, the work group appointed a task force to conduct an initial scoping of the GYE agencies regarding development of the CEM. After several workshops and brainstorming sessions, a small technical committee was

appointed to develop the conceptual model (Puchlerz 1984). The technical committee

expanded upon earlier cumulative effects modeling efforts to develop a methodology to

quantify the spatial and temporal impacts of human activities on grizzly bears and their

habitat. Due to the large size of the Yellowstone grizzly bear ecosystem and the complex

nature of human activities within this ecosystem, it was recognized that computer

implementation would be necessary to efficiently manage the required data, and thus

spawned the CEM (USDA 1985).

A first draft of the Cumulative Effects Analysis Process for the Yellowstone

Ecosystem (hereafter referred to as the "Blue Book") was released for review in October

1984. This document described the conceptual framework, assumptions, equations and

coefficients associated with the GYE CEM. Copies of the manual were sent out for

review to Forest Supervisors of the GYE National Forests, Montana Fish Wildlife and

Parks Department, Yellowstone National Park, Plum Creek Timber Company, US Fish

and Wildlife Service Grizzly Bear Recovery Coordinator, Forest Service Regions 1, 2 and

4, Intermountain Forest and Range Experiment Station, Interagency Grizzly Bear Study

Team, University of Montana, Wyoming Game and Fish Department, and Idaho Fish and

Game Department. Responses were requested by November 30, 1984 (Breazeale 1984).

Responses were received from the majority of reviewers. A meeting was held in

January 1985 at which the "Blue Book" was again reviewed. Comments received were

analyzed and incorporated into a revision of the document. Another draft of the "Blue

Book" was sent out to the same mailing list for use and further review in June 1985

(undated memo to FS files).

Using the "Blue Book" as a guide, the first version of the CEM was programmed in 1984 and 1985 by Kim Barber and Dave Winn, Forest Service personnel of the Regional Office in Ogden, Utah (Winn and Barber 1985). This prototype was used to assess the impacts on grizzly bears for large-scale and very controversial projects such as the Ski Yellowstone resort proposed on Gallatin National Forest land near West Yellowstone, Montana (Grotzinger 1987), the renovation of Fishing Bridge campground in Yellowstone National Park (USDI 1988) and an evaluation of Management Area 9 on the Targhee National Forest (USDA 1988).

These first attempts at using the CEM were somewhat frustrating, as the model was very complex and run-time for a single analysis could take several days. Nevertheless, these pioneering efforts were viewed positively as they allowed biologists to quantify the impacts from a multitude of human activities over large areas of land in a relatively expeditious manner. The same process would have taken much longer if attempted without the aid of computer processing. Also, these first efforts would lend great insight for future evolution of the CEM.

The original CEM (1985) used the Map Overlay Statistical System (MOSS), one of the first Geographic Information Systems (GIS), to process the data and algorithms developed for the GYE. Although MOSS was very powerful software and considered "state of the art" at the time, the first CEM was slow and cumbersome and could monopolize significant amounts of time on a main-frame computer, often to the detriment of other users. Also, MOSS was the GIS used nationally by the Forest Service, but other agencies involved in grizzly bear management in the GYE were typically using other GIS

packages such as GRASS, ERDAS and ArcInfo. These factors sparked the first serious revision of the model.

In 1987 the technical committee was called together at the request of the Yellowstone Ecosystem Grizzly Bear Subcommittee to review the cumulative effects analysis process and the current version of the CEM to "evaluate the need for further development, revision, or complete overhaul." This review resulted in a recommendation to the Subcommittee to re-program the CEM from scratch in order to circumvent the complications associated with MOSS software (Puchlerz and Weaver 1987).

John Weaver, National Grizzly Bear Habitat Coordinator for the Forest Service at the time, took on the first revision of the CEM in 1987. Upon the advice of the technical committee, he elected to pursue an independent contractor for the task to increase ownership of the CEM process among all involved parties, and to avoid complications associated with turnover of agency personnel. The project was awarded to Collin Bevins of Systems for Environmental Management (SEM) in Missoula, Montana. The new version of the model (CEM2) would still rely on MOSS for map display purposes, but not for the actual model processing and calculation of numerical outputs (Bevins 1988). CEM2 was used to evaluate the impacts of various timber harvest proposals on the Gallatin, Targhee and Bridger-Teton National Forests.

The new version improved upon the original CEM in several ways. It employed a menu-driven interface, thereby reducing the complexity of the model operation. CEM2 was capable of processing an entire Grizzly Bear Management Unit (BMU) at one time whereas the original version was limited to processing single quads of data at a time. The

new version employed a more efficient mechanism for calculating the zone of influence around activities, and was capable of measuring the effects of overlapping zones of influence. CEM2 provided a means for storing the results of each analysis and producing comparative reports (Bevins 1988). However, the processing of an analysis using CEM2 still made considerable time demands on a main-frame computer. Also, the newer version was configured for the Data General computer system, the standard used by the Forest Service, but not generally available to the sister agencies.

The next major revision of the CEM was initiated in 1988 with the appointment of a new Forest Service Grizzly Bear Habitat Coordinator, Rodd Richardson. This effort would emphasize two major considerations for the next version of the model. First, the CEM would be made more compatible among all agencies in the GYE by converting to a personal computer (PC) platform. The second consideration reached beyond the GYE to include other grizzly bear ecosystems in the conterminous United States and the models being used to assess human impacts in those areas.

By this time, CEMs were being developed in the Greater Yellowstone Ecosystem (GYE), the Northern Continental Divide Ecosystem (NCDE) and the Selkirk and Cabinet-Yaak (S/CY) ecosystems. All of these drew on the basic concepts developed early on in northwest Montana and the GYE, but beyond that there was little coordination of the cumulative effects modeling efforts between these ecosystems. Many of the original modeling teams and task forces had dissolved due to personnel turnover. It was recognized that, other than for ecologically-based differences between the ecosystems, there was a need for more consistency in the modeling efforts.

A comparison between models was conducted by Forest Service personnel in 1986. This work indicated that the objectives and basic model design were similar between ecosystems, but that biological differences and disparate data availability among the ecosystems necessitated variation in specific model design. The most notable differences between the models occurred between the GYE and the northern ecosystems. (Escano 1986). Subsequent efforts were made by the USFS National Grizzly Bear Habitat Coordinator at that time, to coordinate modeling efforts between the ecosystems with the purpose of standardizing basic model structure, terminology and outputs (Weaver 1987). However, results of these efforts are not well documented.

In January 1989, official modeling teams were re-established for the various grizzly bear ecosystems and team leaders were designated. Team leaders met periodically to review the existing grizzly bear models and develop strategies for standardizing grizzly bear CEMs across all ecosystems. As Team Leader for the GYE modeling team, I conducted a comprehensive model comparison in March 1989. This effort resulted in a report on model attributes such as analysis units, seasons, submodels, outputs, habitat/displacement/mortality variables, activity groups and definitions, zones of influence, and application of disturbance and mortality coefficients (Dixon 1989).

This model comparison provided a starting point for modeling teams to standardize CEMs across grizzly bear ecosystems. Differences based on ecological variation between grizzly bear populations, and/or data availability among the ecosystems were identified and documented as such. All other model variations were standardized for all ecosystems and the resulting conceptual CEM was referred to as the "Unified Model".

A document describing the Unified Model titled <u>CEM - A Model for Assessing</u> <u>Effects on Grizzly Bears</u> (hereafter referred to as the "Green Book") was prepared. The first draft of this document was released for review by modeling teams in June 1989. Comments received were incorporated, the document was revised, and a second draft was released in December 1989. Further comments were received, the document was again revised, and the final was released in April 1990 (USDA 1990).

The Unified Model was programmed for PCs, with the contract again awarded to SEM in Missoula, Montana. Although some major programming changes have since been made, the standardized parameters established for the Unified Model are currently in use with the GYE CEM. Specific model design and associated parameters will be discussed later in this document.

The PC version of the Unified CEM was much more efficient in terms of processing and run-time. As most users had a dedicated machine for the CEM, the impact on other users was eliminated. Run-time for a typical analysis was reduced from a matter of days to a matter of hours. The new version was converted to a command-driven system to provide a wider range of options to model users.

At the time of this version's development there was an on-going philosophical debate about what constituted a true cumulative effects analysis versus an incremental effects assessment. In general, those most familiar with the CEM felt that it did an admirable job of quantifying the collective effects of activities at a large scale, but that the lack of a specific tie to grizzly bear demographics made the CEM fall short of a true cumulative effects analysis. Thus, the programmer (C. Bevins) bestowed upon this

version of the software a new acronym of "ICE" - which stands for "incremental cumulative effects".

The initial version of the ICE Tool Kit was made available to users in April 1991. This software package provided CEM users with multiple options for analyzing land management alternatives and displaying both numeric and graphic results (Bevins 1991). Numeric outputs were displayed in tabular form and graphic outputs (maps) were formatted so that they could be displayed with any of the various GIS technologies currently employed by the GYE agencies. The PC platform for the ICE software greatly expanded the availability to users across the GYE. Also, the ICE software was eventually ported to a UNIX platform which further improved the performance of the CEM in a more powerful workstation environment. This version of the CEM was used to assess impacts of the New World Mine project on the Gallatin National Forest, as well as to evaluate multiple land management scenarios proposed under the Forest Plan revision on the Targhee National Forest (USDA 1997).

ICE software was also tested on portions of Yellowstone Park data to compare outputs with results of previous CEM versions. A ten-fold difference in the habitat value scores for a given area was observed between model versions. This difference in habitat value was at least partially attributed to the fact that ICE software accumulations were on a 5-acre cell basis whereas previous model versions calculated habitat value on a per acre basis. Although the absolute habitat value scores differed dramatically, the relative ranking of various areas reviewed remained similar (Renkin pers. comm.)

The first version of the ICE software (ICE6) was developed to interact with ORACLE, a relational database management system. This interface was a contract requirement imposed by the Forest Service as ORACLE was the database manager used by that agency. Although the ICE6 software ran much faster than previous versions of the CEM, it still took several hours to run a typical analysis. Most of this time consumption was attributed to the tie with ORACLE. Collin Bevins proposed a much more efficient model in terms of both time and space requirements by the elimination of the ORACLE connection. The Yellowstone modeling team was in favor of such a revision, but could not secure adequate funding to proceed.

The complexity associated with data preparation and running the model limited the use of CEM to a few individuals throughout the GYE. Due to this lack of CEM skill, in 1996 SEM was awarded another contract to run a large part of the GYE through the ICE6 version of the CEM. In order to facilitate this work, Bevins re-programmed the ICE6 software to eliminate the use of ORACLE, using simple "flat" files for data management instead. The revised software package was dubbed "ICE9". This latest version of the CEM resulted in a major reduction in time and space requirements for the model. Run time for a typical analysis using ICE9 software was reduced to usually less than ten minutes.

With the ICE9 software already developed, SEM offered to provide it to the agencies at a much reduced cost than had been discussed prior to its development. At first only the Gallatin and Targhee National Forests acquired the ICE9 software in order to expedite on-going CEM analyses. By early 1997 ICE9 was revised slightly and

purchased for all major user groups in the GYE. ICE9 is the CEM software currently in place and in use in the GYE.

Over the years of development the CEM conceptual design as well as the computer model were presented at conferences and symposia on grizzly bears, habitat modeling, ecosystem management, and various other topics. This model is widely known nationally and internationally. In the early 1990s representatives of ESRI Corporation, parent company of ArcInfo GIS technology, approached Larry Warren of the Brider-Teton National Forest (GIS advisor to the Yellowstone modeling team) about the CEM. The ESRI people were curious as to why the model (being primarily based on geographic information) was not programmed directly with a GIS. Difficulties of the modeling experiences with MOSS were explained, as well as complexities of the CEM that the modeling team felt would limit the effectiveness of direct programming with a GIS; e.g. multiple attributes for individual map features and daily scheduling of activities.

The ESRI people were very intrigued with the CEM and offered to program it using ArcInfo at no cost to the agencies, although ESRI would retain the rights to distribute the end product to other consumers. This proposal was presented to the modeling team, and it was agreed to allow ESRI to proceed with Larry Warren acting as the agency liaison for the project. As with most projects of this complexity level, workload was underestimated for the "no cost to the government" version and a contract for the project was eventually awarded to ESRI. A prototype of the ArcInfo version was presented to the modeling team in June 1996.

The original contract agreement with ESRI was to port the ICE6 version of the CEM into ArcInfo. As of October 1997, these obligations have been met. However, some programming errors were discovered in the ICE6 software that have since been corrected in the ICE9 programs but not in the ArcInfo version. These problems have been identified and can be rectified in the ArcInfo programs, but current efforts are focused on ICE9 software and there are no plans to pursue further development of the CEM in ArcInfo at this time (Warren pers. comm.)

Intended/Appropriate Uses

Examples of model uses up to this point reflect that the majority of CEM applications had been to evaluate projects. This situation was attributable to the urgent need for a project-level analysis tool coupled with extensive time and personnel requirements for completion of an ecosystem-wide database. There has always been some concern as to whether the database and coefficients used with the CEM reflect the level of accuracy necessary to evaluate impacts at a site-specific project level. Although the GYE CEM database is believed to be one of the most comprehensive in the world for a project of this magnitude, it nevertheless was produced largely by extrapolation and approximation. Also, coefficients used in model calculations are based on estimates of average grizzly bear responses to habitat and human activities across the entire GYE.

At a modeling team meeting in December 1996, Richard Knight, Team Leader of the Interagency Grizzly Bear Study Team (IGBST) for over 20 years in Yellowstone, indicated that his recollection of the original intent of the CEM was to monitor GYE-wide

human activity levels and resulting effects to grizzly bear populations. He pointed out that it was never intended for use at the project level, and that the GYE was initially broken down into smaller units (BMUs and Subunits) in response to hardware/software limitations. However, development of the model was initiated at least partly in response to the legal requirements to assess the cumulative effects of projects proposed in grizzly bear habitat. Indeed, two of the main documents describing the GYE CEM make reference to use of the model for assessing impacts of individual activities.

The first comprehensive documentation of the GYE conceptual model titled Cumulative Effects Analysis Process for the Yellowstone Ecosystem (aka the "Blue Book") states that "The ... (CEM) is designed to: 1) Quantify *individual* and collective effects of land uses and activities in space and through time, and 2) Provide managers an analytic tool for evaluating *alternative decisions* relative to grizzly bear recovery goals and objectives" (*emphasis* added) (USDA 1985). The next article produced to describe the "Unified" CEM, titled CEM - A Model for Assessing Effects on Grizzly Bears (aka the "Green Book") states that "The CEM ... complements other analyses performed at the *project level* and is used in conjunction with this information to *compare project alternatives...*" (*emphasis* added) (USDA 1990).

These statements were not intentionally misleading. Managers and field biologists alike were desperately in need of a tool for evaluating cumulative impacts associated with individual projects, and at the inception, many of the developers behind the CEM believed that this model could provide the tool. However, experience has taught us that using the model for specific project assessments can set a dangerous precedent. As mentioned

above, using the CEM to quantify the effects of a given project at a scale that is biologically meaningful to the bear will almost always show that the additional or *incremental* impact of any given project will be negligible. The important factor to address is the *overall* reduction in habitat effectiveness at the landscape scale, considering *all* on-going activities.

In May 1991, the USFS Grizzly Bear Habitat Coordinator (Rodd Richardson) established a protocol for interim use of the CEM relative to specific projects. This direction basically stated that for project analyses the CEM would be run concurrent with an *independent* biological assessment. Results from the two efforts could then be compared to evaluate how well model outputs reflected the intuitive conclusions drawn by the project biologist. This protocol was established in recognition of the model's limitations, but also as an indication that it could be useful at the project level for simulation of activity placement and scheduling, simulation of mitigation measures designed to benefit those bears affected by the project, and as a record keeping and monitoring tool to keep track of incremental change.

It is important to note that the CEM as currently designed has the *capability* to quantify impacts of multiple human activities at any scale, but model outputs cannot be interpreted to reflect direct impacts on individual bears. It is the data and coefficients driving the model that lack the accuracy necessary to adequately assess project-level impacts. In order to use CEM in this manner, we would have to field-verify a much greater proportion of the habitat and activities mapping (an exhaustive task for an area of approximately 6 million acres) and we would have to know *specifically* how bears utilize a

given area, and *exactly* how particular human activities are likely to affect the bears using that area.

Given these considerations, in October 1996 the modeling team attempted to produce a statement of appropriate use for the CEM and came up with the following: "CEM is a tool for estimating the habitat value and habitat effectiveness for the grizzly bear in the Yellowstone Recovery Zone and to monitor fluctuations in these values due to vegetative changes and disturbance from human activities at the Bear Management Unit or Subunit level" (Barber 1996).

The Yellowstone Modeling Team

The Yellowstone Modeling Team (YMT) is a group of biologists and GIS/computer specialists that are responsible for the development, oversight and implementation of the GYE CEM and associated database. The original modeling team was the technical committee established in 1984. This team consisted of T. Puchlerz (Chairman) - Gallatin National Forest, plus representatives of the Bridger-Teton National Forest, USFS Regions 1 and 4, IGBST and Yellowstone National Park (Puchlerz 1985).

The last meeting of the original technical committee occurred in October 1987. In December 1988, Rodd Richardson, USFS National Grizzly Bear Habitat Coordinator, called together agency personnel who were currently involved with the CEM. By this time only a couple members of the original technical committee remained in the GYE. A new modeling team was established with myself of the Gallatin National Forest, as Team Leader. Other team members included representatives of the Bridger-Teton, Targhee, and

Shoshone National Forests, Grand Teton and Yellowstone National Parks, Forest Service Regional Offices 1, 2 and 4, the US Fish and Wildlife Service, and the IGBST. In 1994, Region 4 of the Forest Service offered the services of Ralene Maw to serve as a database coordinator for the GYE CEM. In 1995, team leadership was turned over to Kim Barber, Shoshone National Forest and Roy Renkin, Yellowstone National Park as co-leaders. See Appendix A for a list of past and present modeling team members.

In 1995, the following charter was developed for the YMT: "Develop and maintain the Cumulative Effects Model (CEM) and associated databases, and provide coordination and consistency regarding all aspects of the GYE CEM." Some of the various aspects of CEM under this charter include: model parameters and rule sets, validation efforts, appropriate uses of CEM and associated database, peer review and interpretation of model outputs, data standards, definitions and formats, data collection and updates, data distribution, and coordination with other GYE databases and other grizzly bear modeling efforts (Maw and Barber 1995).

CHAPTER 2

DATABASE

The database for the GYE CEM is a massive collection of geographic and descriptive information and is probably one of the most comprehensive of its kind in the world today. GYE agencies began collecting this data in the early 1970s and did not achieve a complete database for the GYE CEM until 1997. This effort not only spanned several decades, but also involved hundreds of people and cost in the millions of dollars. The database can be broken down into four major categories: boundaries, vegetative habitat, supplemental habitat, and human activity layers. Each of these will be described in detail.

Boundaries

The CEM requires user-defined boundaries as reference for model output. There is currently no limit to the number of boundaries a user may identify for a CEM run. The standard boundaries used in CEM analyses include Bear Management Units (BMU), subunits, administrative units, and female grizzly bear home ranges. Examples of other boundaries that might be of interest for a CEM analysis include hydrologic boundaries such as a drainage or watershed, project area boundaries, wilderness areas, hunting

districts, etc. The CEM provides results of the analysis for each boundary defined. The BMU and subunit represent the minimum scale for CEM analysis that produce outputs relevant to grizzly bear management. However, smaller internal boundaries such as those listed above provide information about what proportion of impacts are occurring within areas of particular interest; e.g. female grizzly bear home ranges.

The GYE grizzly bear recovery zone covers approximately 6 million acres. In dealing with an area of this size it became necessary to break it down into smaller units, partly to accommodate the limited capabilities of early GIS/modeling technology, but also for ecological and administrative reasons. According to the "Blue Book" (USDA 1985) the GYE was divided into Bear Management Units (BMUs) and Subunits in order to:

- "be able to assess existing and proposed activities without having the impacts washed out by too large an area."

- "closely match individual grizzly bear use patterns and habitat ecology" and

- "prioritize areas where management needs would require a cumulative effects analysis"

David Mattson of the IGBST was the primary author of the BMU and subunit boundary concept for the GYE in 1984. BMU boundaries were delineated at the scale of the life range of a female grizzly bear in the GYE. The intent was to define areas that had biological relevance to grizzly bears, would serve to minimize overall fragmentation of grizzly bear habitat, and could be used for mitigation purposes in a way that would maximize benefit to those bears most impacted by human activities (Mattson pers. comm.)

BMUs were delineated based on grizzly bear radio relocation data collected between 1979 and 1983. Areas were defined according to the number of radio relocations obtained during any or all of the bears' active seasons. "Active" seasons were defined as spring (March through May), summer (June through August) and fall (September through November). Areas with concentrated use by grizzlies during all active seasons provided the core for some BMUs. Likewise, areas of one- or two-season use, as well as non-use areas served as the core for other BMUs. Prominent topographic features between the seasonal use areas were used to further define the BMUs (USDA 1985).

The initial BMU mapping effort in 1984 resulted in the following stratification of the GYE: Madison, Washburn, Lamar/Slough, Crandall/Sunlight, Firehole/Hayden, Pelican/Clear and Two-Ocean/Lake BMUs showing known areas of extensive, three-season use; Gallatin, Hellroaring/Bear, Shoshone, Thorofare, Bechler/Westslope and Teton BMUs having substantial bear use during only one or two seasons; and Boulder, Plateau, and Henry's Lake BMUs receiving little or no bear use (USDA 1985).

Initial BMU delineations were derived from IGBST radio relocation efforts that were concentrated in and around Yellowstone National Park. Data from state and federal biologists around the GYE indicated that there were additional grizzly bear use areas and important habitat in the Taylor/Hilgard area of the Gallatin and Beaverhead National Forests, the Buffalo/Spread Creek area of the Bridger-Teton National Forest and the South Absaroka area of the Shoshone National Forest. Therefore these units were added to the original BMUs to create a total of 18 in the GYE. Figure 2 shows the original BMU boundaries as delineated in 1984.

Figure 2: Original Bear Management Boundaries (BMU) developed in 1984.

Subsequent refinements were made to BMU boundaries as additional data became available. For example, the Taylor/Hilgard BMU that was added to the original 15 BMUs was initially a linear strip along the west edge of the ecosystem. Members of the technical committee, assisted by area biologists and managers with local knowledge, re-defined the internal boundaries of the Madison and Gallatin BMUs to adjust the Taylor/Hilgard Unit so that it more closely matched the seasonal bear use patterns attributed to the original BMUs (Puchlerz pers. comm.)

In 1988, the IGBST requested GYE agencies to provide written descriptions of BMU boundaries in order to create an accurate map for purposes of recording grizzly bear locations. From this information a map was created and distributed to the agencies for review. With agency revisions, a BMU base map was digitized and submitted to the Grizzly Bear Subcommittee for approval. Upon receiving Subcommittee sanctions, the first digital BMU map for the GYE was released in October 1989.

In conjunction with the revision of the Grizzly Bear Recovery Plan in 1993, it became apparent that the current BMU alignment would never allow achievement of stated grizzly bear recovery goals. This situation resulted from the original delineation of some BMUs based on a paucity of seasonal bear use. Therefore, the following changes to BMU boundaries were made: 1) part of the Madison BMU was included with the Henry's Lake and 2) part of the Lamar/Slough BMU was added to the Boulder. Figure 3 represents the current BMU boundaries as of October 1997.

BMUs are further divided into subunits to provide greater landscape resolution by accounting for additional seasonal heterogeneity of grizzly bear use patterns within a

Figure 3: Bear Management Unit (BMU) boundaries as of October 1997.

BMU. The typical subunit generally consists of a major drainage enclosed by portions of intervening ridges. The subunit represents the most energetically efficient area for a bear, and is correlated to the annual home range size of an adult female grizzly bear in the GYE (USDA 1985).

Subunits were delineated for the BMUs within Yellowstone National Park in 1984, again using primarily IGBST radio relocation data. Additional subunits were delineated for the BMUs on National Forest lands in 1989. Further refinement of subunits would occur in later years with additional review by local area biologists from state and federal agencies. See Figure 4 for subunit delineation as of October 1997.

Vegetative Habitat

This data layer contains information on landscape patterns based primarily on vegetation composition and structure. It also represents geologic and hydrologic features, as well as human developments on the landscape such as towns, airstrips and agricultural fields. Vegetation was mapped using the habitat type concept (Daubenmire 1966) according to manuals produced by Pfister et al. (1977) and Steele et al. (1983). The habitat type approach is an ecosystem classification method for describing forest communities. This method is used to identify vegetative potential on forested sites based on the geographic, physiographic, climatic and edaphic features of each type (Pfister et al. 1977). Since the habitat type approach represents the vegetative potential of a forested community under climax successional conditions, it primarily identifies the understory vegetative communities of various habitat types.

Figure 4: Bear Management Unit (BMU) and Subunit boundaries as of October 1997.

A complementary cover type coding scheme developed by Despain was used to represent the present overstory vegetation. Cover type codes indicate the predominant tree species in the forest canopy and current successional stage. This information is presented in the <u>Grizzly Bear Habitat Component Mapping Handbook for the Yellowstone Ecosystem</u> (Mattson and Despain 1985).

The habitat type approach was used to classify only forested habitat components. Nonforest habitat components such as meadows, shrublands, alpine tundra, rock and water, were coded using a more coarse definition of landscape units with less ecological resolution than the habitat type approach. This method was employed as the nonforest habitat types occurred at a much finer scale than could adequately be represented with a 5- to 10-acre minimum mapping resolution (Despain pers. comm.). The mapping handbook provides a description of the generalized nonforest habitat components as well as a key to mapping these vegetative types (Mattson and Despain 1985).

The ecological approach to recording vegetation structure and landscape patterning lends itself well to ecosystem management. The entire landscape was mapped to reflect successional patterns and disturbance regimes. Vegetative habitat mapping in the GYE was conducted using aerial photo interpretation and extensive ground truthing. This effort was initiated in the early 1970s with the purpose of producing the first vegetation map for Yellowstone National Park. Since this project was essentially completed prior to initiation of the CEM effort for grizzly bear habitat evaluation in the GYE, it provided the basis for vegetative habitat mapping of the surrounding National Forest and Park land. However, the procedure was refined somewhat so as to better meet

the needs of grizzly bear habitat assessment, and also to comply with mapping standards established for the National Forests. This refinement resulted in notable mapping discrepancies between Yellowstone National Park and the rest of the grizzly bear recovery zone. Specific mapping procedures employed by the various administrative units is described below.

Yellowstone National Park

In 1971, Yellowstone National Park initiated a project to produce a comprehensive vegetation map for the Park. The habitat type approach was chosen for the project, as this method produces an ecologically based classification system and would also be compatible with vegetative work being conducted on adjacent federal lands. At first, LANDSAT satellite imagery was considered for the project. It was later determined that the utility of LANDSAT data was limited to distinguishing coniferous forest from other vegetative types, and determining the density of forest cover (Root et al. 1974). As the project called for greater landscape resolution than LANDSAT data could provide, the satellite imagery concept was abandoned and a more labor-intensive aerial photography interpretation approach was adopted (Despain pers. comm.)

In 1973, transects were established for field sampling that would be representative of Yellowstone National Park vegetation types. The transects were mapped on 1969 to 1972 color aerial photography, at a scale of 1:15840. Sampling routes were based on known correlations between geology, climate and vegetation. The transects were carefully selected to ensure sampling that would cover the elevation range and geologic

parent materials present within the Park (Despain pers. comm.)

In 1974, field crews of botanists were hired and trained in habitat typing to improve their skills in identification of indicator species for GYE habitat types. The field crews visited transect locations on the ground, recording habitat types and percent cover of indicator species in forested habitat types, as well as listing all species found in nonforest types. As habitat typing manuals for Wyoming were not available in the early 1970s, the field crews mapped vegetation using Cooper's preliminary work (which would eventually be incorporated into Steele et al. 1983). Pfister's (1977) habitat types for Montana were also used when they became available (Despain pers. comm.)

While the field crews were out mapping habitat types along the transects, Despain was also out in the field with aerial photos training his eye to the correlations between habitat types on the ground and associated characteristics on the aerial photos. He then used this information, in addition to data collected by the field crews, to delineate habitat types and transitional ecotones on aerial photos. Schedule requirements for the project did not allow for delineation of "effective areas" on photos, so entire photos were mapped, using every other photo from each flight line to obtain full coverage of the Park (Despain pers. comm.)

Vegetative polygons were transferred from the aerial photos to 15 minute topographic quad maps (scale = 1:62500) using simple ocular transfer. These base maps were used because neither orthophoto base maps nor 7.5 minute topographic maps (scale = 1:24000) were available for Yellowstone National Park at that time. Habitat type units were recorded at a minimum mapping resolution of 10 acres. Inclusions of less than 20

percent of a mapped polygon were ignored unless they could clearly be broken into polygons at least 10 acres in size. The entire field mapping project took place in Yellowstone National Park between 1973 and 1979 (Despain pers. comm.)

Vegetative habitat type maps were sent to the National Park Service Regional Office in Denver, Colorado for digitizing. The first maps sent in were digitized by hand, and later maps were scanned when this technology became available. Digital maps were returned to Yellowstone Park for proofing and correction of errors (Despain pers. comm.)

As habitat typing was being completed in the late 1970s, the same aerial photos were used for cover type delineation of forested habitats. The cover type classification system developed for this project (Despain 1977) would later be incorporated into the mapping handbook for the rest of the GYE (Mattson and Despain 1985). Cover type classifications were based on species composition and successional stage of the overstory vegetation. Once cover types were mapped, the aerial photos were sent to the Denver Office where the delineations were transferred to 15 minute topographic quad maps using a zoom transfer scope and then digitally scanned (Despain pers. comm.)

These mapping efforts provided separate maps for habitat and cover types. When the surrounding administrative units later started mapping habitat and cover type combinations as a single map layer according to the mapping handbook (Mattson and Despain 1985), Yellowstone personnel used GIS technology to overlay and combine the two layers for the Park. This project initially resulted in a plethora of "slivers" between the newly created polygons. By reassembling the polygons into a 5-acre raster coverage, most of the "slivers" were eliminated (Despain pers. comm.)

Gallatin National Forest

Habitat mapping for most of the National Forests and Grand Teton National Park followed the procedures outlined in the mapping handbook (Mattson and Despain 1985). Following is a detailed description of this process as implemented on the Gallatin National Forest. Vegetative habitat component mapping occurred in three phases: pre field, field, and post field. The pre field phase consisted of aerial photo interpretation and delineation, and orthophoto base map preparation. Aerial photography used for the project was from an August 1981 flight, at a scale of 1:24000. First, effective areas were determined for the aerial photos to avoid delineation of habitat components at the outer edges of the photos where distortion can occur from the tilt of the aircraft and curvature of the earth's surface.

Within the effective areas habitat components were delineated directly onto aerial photos using a stereoscope to visualize topographic relief. Homogenous landform types (vegetative, rock and water) were identified by polygons on the aerial photos. Delineation of habitat polygons incorporated features such as aspect, elevation, slope, color, texture, density and size class of tree species, and topographic location (e.g. ridge top, side slope, valley bottom, flat land, etc.) Polygon size was constrained by a 5-acre minimum mapping resolution. In situations where multiple vegetative types were intermingled such that they could not be broken out into 5-acre or larger polygons, the combinations were mapped as a single habitat polygon and coded as "mosaics". (Coding of vegetation polygons will be described below.) An example of a mosaic would be a forested area interspersed with less than 5-acre meadow openings.

Once habitat polygons were delineated on aerial photos they were transferred by simple ocular method to mylar orthophoto base maps. USGS 7.5 minute orthophoto quads were used for base maps. Vintage of the base maps was generally 1976, and scale was again 1:24000. Care was taken to ensure that habitat polygons at the edge of base maps matched those on the adjoining quads. Parts or all of 57 quads were mapped to provide vegetative habitat component coverage for the Gallatin National Forest portion of the GYE grizzly bear recovery zone.

In preparation for the field phase of habitat component mapping, sample aerial photos were selected for field verification of habitat and cover types. Sample photo selection targeted every other photo from every other flight line for ground verification. This sampling scheme was utilized so that every unsampled photo would be adjacent to at least one field sampled photo. Figure 5 shows the sample photo selection strategy for field verification.

Once sample photos were selected, a process of "like-typing" was conducted to minimize the actual field time required to ground truth a photo. "Like-typing" was a process where each polygon on a photo was assigned a number based on physical attributes such as aspect, elevation, tree species present, structural and successional composition, and apparent moisture content of vegetation; e.g. wet, moist or dry. Polygons with similar attributes were given the same numerical identifier and field samplers were only required to visit one representative polygon of each number on a sample photo. Figure 6 shows an example of aerial photo delineation and "like-typing" for field samples.

Figure 5: Field sample photo selection scheme. Every other photo
(circled) from every other flight line visited on the ground.

Figure 6: "Like-typing" on field sample photo. Only one polygon for each numeric identifier visited by field crews.

Mylar overlays were prepared for field sample photos with polygon delineations and "like-typing" identification in each polygon. Field coding forms accompanied the photos. These forms recorded the name(s) of field personnel, date sampled, quad on which the sample photo was located, and spaces for recording the habitat/cover type code(s) for each polygon visited.

A habitat component mapping workshop was held in Gardiner, Montana for GYE field mapping crews in June 1985. At this session, field crews were instructed in aerial photo interpretation, orienteering and habitat typing techniques. Gallatin Forest personnel followed procedures established at the workshop for field mapping of vegetative habitat components. Portions of the Gallatin Forest were field mapped from 1985 to 1987. In 1988 catastrophic fires in the GYE prevented any field mapping for that season. Field mapping did not occur until 1992 in order to allow time for habitat type indicator species to become fully re-established. The last of the field sampling phase for habitat component mapping on the Gallatin Forest occurred in 1995.

The post field mapping phase consisted of transferring field data to the orthophoto base maps. This data plus other existing information was used to extrapolate habitat component codes to those polygons that were not sampled in the field. Extrapolation was conducted by personnel trained in aerial photo interpretation and habitat typing techniques. Field sampled photos were compared with adjacent unsampled photos. Polygons in the unsampled areas were assigned the same vegetative habitat component codes as sampled areas with similar features. Additional information was gained from timber stand exam data, range allotment inventories, soils type maps and broad-scale

habitat type maps. Again, extra effort was made to ensure that adjoining polygons on adjacent quads had the same vegetative habitat component codes.

Once all polygons had been assigned codes, the final vegetative habitat maps were produced either on plain frosted mylar or mylar orthophoto prints. These maps were drafted in ink and labeled in preparation for digitizing. One of the tasks performed in this step was the elimination of lines separating polygons with the same vegetative component code. This procedure minimized the overall number of polygons and thus reduced digitizing costs and computer storage requirements. Final ink copies of the habitat component maps were carefully checked for drafting, coding and edge-matching errors prior to being sent off for digitizing.

Vegetative habitat maps that were completed prior to the 1988 fires (Madison, Gallatin, Hilgard, Lamar and Crandall/Sunlight BMUs) were sent to REDCON Data Consultants, a private firm in Bountiful, Utah, for digitizing under a GYE-wide contract. REDCON digitized the maps and returned them with check-plots and the digital information on 9 mm tapes, to the Gallatin National Forest. Check-plots and digital tapes were reviewed for errors, corrections were made, and the data were stored for future use with the CEM.

As mentioned earlier, the fires of 1988 resulted in suspension of habitat component mapping activities on the Gallatin Forest. Once this process resumed in 1992, the digitizing contract with REDCON had expired. Vegetative maps for the remainder of the Gallatin Forest were completed in 1997 (Hellroaring/Bear and Boulder/Slough BMUs). This mapping effort followed the same procedures as outlined above, with the exception

of digitizing. Instead of preparing a final manuscript complete with polygon delineations and labels, only the polygons were transferred to the final map. The blank polygons were then scanned at the Forest Service Regional Office in Missoula, Montana and the digital product was retrieved electronically. Gallatin Forest personnel edited the digital product for errors and completed the data entry necessary to assign the habitat component code attributes to the digital files.

Vegetative habitat component codes are 5-digit numeric labels that represent the habitat/cover type combinations for forested components, and the generic descriptions developed for nonforest types. Forested habitat type codes developed by Pfister et al. (1977) and Steele et al. (1983) are 3-digit codes. Cover type codes for forested components are 2-digit codes that represent the overstory species composition and successional stage. Nonforest types were assigned general 5-digit codes that begin with three leading zeros. The last two digits of nonforest type codes typically indicate the dominant vegetation present; e.g. grass, forb or shrub, and the relative moisture content; e.g. wet, moist, or dry and are also used to represent rock and water (Mattson and Despain 1985). Appendix B lists vegetation codes and coefficients used with ICE9 CEM software as of October 1997.

Mosaics (vegetative polygons with more than one type that could not be broken out in 5-acre or greater sections) were labeled with multiple codes, with habitat types listed in order of proportion. Figure 7 shows a sample of a Gallatin Forest vegetative habitat component map.

Figure 7: Vegetative habitat component mapping polygons and labels.

Shoshone National Forest

The Shoshone National Forest took a slightly different approach to vegetative habitat mapping than outlined in the mapping handbook (Mattson and Despain 1985) and described above for the Gallatin National Forest. This divergence from the standard was justified for two reasons. First, there was considerably more existing vegetation data available for the Shoshone than for other National Forests. Secondly, the Shoshone contracted out the vegetative habitat mapping to K. Houston, who had several years of prior experience in vegetative analyses and mapping on the Shoshone National Forest, including preparation of a "Grizzly Habitat Map" in 1978 (undated memo).

Pre-existing data available to the Shoshone for this project included Forest Plan habitat type maps, geology maps, North Absaroka fire plan habitat type maps, soil survey maps, habitat type mapping conducted by Mealey and Mattson in the 1970s.

In an undated memo from the Shoshone National Forest files, Houston described his methodology, which is summarized as follows. Available data (listed above) were assembled and field work was concentrated in those areas lacking information. Data regarding slope, elevation, aspect, parent material, habitat type and ecotones were recorded in the field. From this information "target diagrams" were developed to extrapolate forest habitat type information (the "target diagram" concept was not described in the memo, only referred to as a method). Nonforest types were identified through previous mapping efforts and from color infra-red aerial photography.

Although Shoshone personnel used a slightly different mapping technique, the final product was similar to that produced by other forests. With the abundance of pre-existing data, they did not feel it necessary to conduct the same degree of field sampling as required in other areas of the ecosystem. Consequently, the Shoshone was able to produce a similar product at less cost than the other National Forests and Parks.

The remaining National Forests (Beaverhead, Custer, Bridger-Teton and Targhee) and Grand Teton National Park, were mapped using methods consistent with those outlined in the mapping handbook (Mattson and Despain 1985) and described above for the Gallatin National Forest. Vegetation mapping efforts for these remaining administrative units will therefore not be discussed further.

Fire Update

The catastrophic fire event of 1988 burned well over a million acres in the GYE. This phenomenon dramatically changed the character of grizzly bear habitat as mapped for

the GYE CEM. Obviously, updating the vegetative habitat mapping to reflect cover type modifications resulting from the fires would be an undertaking of significant magnitude. Fortunately, the ecologically-based coding scheme utilized for this data lends itself to a disturbance-related update, since habitat types are unlikely to change due to the fires and cover type conversion is logically predictable based on habitat type and pre-existing cover type. Satellite imagery was immediately a mechanism considered by the Yellowstone Modeling Team for this project. The National Park Service Washington Office had contracted with EROS Data Center to obtain LANDSAT Thematic Mapping (TM) imagery of the Yellowstone area fires in October 1988 (Despain pers. comm.)

EROS personnel initially conducted an unsupervised classification of the imagery which resulted in 30+ classes of spectral data representing the burned and unburned areas. They then used GIS technology to "mask out" everything but the burned classes, and performed another unsupervised classification in an attempt to identify different classes of burn intensity. Color aerial photography was used in conjunction with the second satellite imagery classification to produce seven final burn intensity classes. These classes were based on fire intensity; e.g. crown fires where all trees were killed vs. mixed crown/ground fires that resulted in a combination of burned, scorched and green trees, and burns that occurred in nonforest areas. The final burn intensity categories are as follows: 1) crown fire in dense forest canopy 2) crown fire in medium forest canopy 3) crown fire in sparse forest canopy 4) mixed fire in dense forest canopy 5) mixed fire in medium forest canopy 6) mixed fire in sparse forest canopy and 7) burned nonforest areas; e.g. meadows (Despain pers. comm.)

A new map of the seven fire intensity classifications was produced and taken to the field in Yellowstone National Park for ground verification. This field exercise indicated that the resulting fire map was fairly accurate, except that it could not be used to detect surface fires where trees were not killed, nor to distinguish between conifer canopy burns and sagebrush canopy burns. The cover type map for Yellowstone Park was used to distinguish the sagebrush types and a final, post fire vegetation map was produced for Yellowstone National Park in 1989. The post fire map was created by overlaying the vegetative habitat map with the fire intensity map. The basic rule set for coding changes was to convert all forested components that had sustained any degree of burn (canopy or mixed) back to a recently disturbed cover type (Despain pers. comm.)

The Yellowstone Park prototype of a post fire vegetation map indicated that the method used was effective and could be used for updating the entire GYE vegetative habitat database and was thus adopted by the modeling team in September 1989. However, the argument was made that not all trees would die in the mixed burns, and therefore the post fire code for those stands influenced by a mixed burn would be coded as a mosaic of burned (early successional, recently disturbed) and unburned (retained the pre fire cover type code).

Initially the modeling team thought it would also be appropriate to convert the codes for burned shrub lands (e.g. willow and sagebrush communities) to grass or forb meadows, depending on the nature and geographic location of the site. However, it was later decided that these types would likely revert back to shrub communities in a matter of a few years, so all nonforest types were left coded as they were pre fire.

With the rule set for modifying the vegetative habitat data in place, the modeling team agreed to pursue a fire update using the burn intensity map developed by EROS and Yellowstone National Park. Utah State University (USU) was awarded a contract through the Forest Service National Grizzly Bear Habitat Coordinator and the Regional Office in Ogden, Utah. Prior to conducting the fire update, the contract with USU required the consolidation of all the vegetation data for the GYE into a single map; an endeavor that had yet to be undertaken.

All administrative units sent existing vegetative habitat digital data to the Forest Service Regional Office in Ogden where data were assembled and checked for gross errors before being forwarded on to USU. The Hellroaring and Boulder BMUs were not included at the time of the initial data consolidation as field mapping was disrupted due to the fires. In order to maintain consistency in the database, these units were subsequently mapped using pre fire (1981) aerial photography. With the exception of field-checked polygons, vegetation was mapped as though it had not been impacted by the fires. Once completed in 1997, these units were sent to the database coordinator in Ogden to be run through the same process for fire update as documented by USU (Ramsey 1991).

The final product delivered by USU in 1992 was a GYE-wide vegetative habitat coverage, in ArcInfo format, complete with attributes for pre fire vegetation, burn intensity, and post fire vegetation. As the fire update process had already been completed for Yellowstone National Park, the post fire coverage was sent to USU for inclusion in the GYE vegetation data consolidation and fire update. Consequently, the pre fire codes are the same as the post fire codes for Yellowstone Park data in the resulting GYE coverage.

The ecosystem-wide coverage is now maintained by the GYE CEM database coordinator in Ogden.

Supplemental habitat

This data layer includes information on environmental factors that are not evident in the vegetative habitat layer. Originally termed the "protein" layer, this data set currently includes information on distribution of ungulate seasonal ranges, fish spawning streams and insect aggregation sites; i.e. habitat features that supply critical energy sources to GYE grizzly bears. The name was later changed to "supplemental habitat" in recognition of some additional features that we may eventually want to include in the CEM, but as of yet lack sufficient data to do so. Examples of these types of features include potential denning areas, security core areas, and travel corridors.

Nine supplemental component types were initially identified for the GYE including moose (*Alces alces*) winter range, bison (*Bison bison*) winter range, high elevation elk (*Cervus elaphus*) winter range, low elevation elk winter range, geothermally influenced elk winter range, carrion concentration areas, traditional ungulate calving grounds, summer-fall ungulate concentrations, and fish spawning areas. Specific definitions and mapping instructions for these types are outlined in the mapping handbook (Mattson and Despain 1985). Insect aggregation sites, primarily army cutworm moths (*Euxoa auxillaris*), were discovered in 1993 and included as important supplemental habitat components for grizzly bears in the GYE and mapped later (Mattson 1993b). Figure 8 represents a supplemental habitat map.

Figure 8: Supplemental habitat component features.

Supplemental habitat components with high energy food sources were mapped independently by GYE administrative units. In 1994 the Greater Yellowstone Coordinating Committee (GYCC), a group of GYE managers with membership that largely overlaps with the GYE grizzly bear subcommittee, approved an elk habitat mapping project for the GYE. Since several types of elk habitat (listed above) had already been mapped for use with the CEM, this data was identified for use as a starting point for the elk habitat mapping project.

The GYCC project was the first serious effort to consolidate any of the supplemental habitat data for the CEM. As this project proceeded it was soon apparent that there were considerable discrepancies in the mapping of elk habitat between the various administrative units. Some edge-matching of supplemental habitat polygons occurred with the elk habitat mapping project, but further review of the database revealed some major differences in the way the rest of the supplemental habitat components were mapped by different administrative units.

At a modeling team meeting in June 1997, Mattson, now with the Fish and Wildlife Resources Department at the University of Idaho, presented a GYE-wide map of supplemental food sources that he had developed for research he was conducting, unrelated to the CEM. As Mattson was the original author of the animal food source definitions included in the mapping handbook (Mattson and Despain 1985) and also developed the coefficients assigned by the model to these map units (USDA 1985), the modeling team decided to adopt his map as a new base for the official supplemental habitat map for the GYE CEM. This new map will be augmented with additional

information from existing supplemental habitat maps (Barber 1997). This process will result in a much more consistent, uniform map of supplemental habitat data for the GYE.

Human Activities

Human land uses were mapped and categorized in very general terms to avoid the complexity and size requirements for a database that incorporates descriptions of all possible human activities on the landscape. Activities are therefore classified according to their potential to disrupt grizzly bear use patterns. A combination of map overlays with corresponding attribute files identify human activities in grizzly bear habitat. The map overlays represent spatial relationships by identifying the geographic location of activities. Attribute files serve to further define the mapped features. These files contain information regarding temporal aspects of activities such as seasonal variations in use, and distinctions between daytime-only or 24-hour use patterns. Attribute files are also used to indicate the intensity of human uses by differentiating between motorized and non-motorized activities and classifying the relative level of use; e.g. high, low or incidental (USDA 1990).

Activities are classified by their nature as being point, linear or dispersed. Point activities are those that occur at a specific location on the landscape and can be identified with an "x" on a map. Examples include campgrounds, outfitter camps, picnic areas and home sites. Linear activity features include roads, trails and other regularly traveled routes (e.g. fishing activity along a stream course) which are represented on maps as line segments. Dispersed activities are those which are not confined to a specific location or linear route, and are displayed as closed polygons on a map. Examples include hunting,

cross-country hiking and snowmobile play areas.

Motorized activities are those that produce loud mechanical noises such as automobile engines, chainsaws and generators. Non-motorized activities obviously have no such loud noises associated with them. Explosives; e.g. road construction and seismic exploration, have their own designation. Duration of an activity is indicated by records of the actual period of use; e.g. a trail may be used only during the summer months (7/1 - 9/30), whereas a paved road may be used on a year-round basis (1/1 - 12/31). Point activities are further refined by differentiation between day-use; e.g. picnic areas and 24-hour use; e.g. back country camp sites (USDA 1990).

Levels of use are generally recorded in relative terms of high and low. An exception was made for closed roads and trails that are known to receive occasional administrative and/or illegal use, but these occasions were not considered significant enough to constitute a "low use" designation. Activity classifications as currently defined for use with the GYE CEM are described in the "Green Book" (USDA 1990).

The broad, general activity classification system developed for the GYE CEM provided for efficiency in mapping the multitude of human activity sources found in this area. However, it also rendered a considerable amount of subjectivity into the mapping task, which resulted in notable discrepancies between (and even within) the maps produced by various administrative units. Early in the project, Yellowstone National Park personnel developed a diagram to key out the different types of activities (USDI 1986). This flowchart was distributed to the other agencies which significantly helped to standardize the classification and mapping of some human activities. However, since the

diagram was developed specifically for Yellowstone Park, it did not address many of the multiple uses associated with National Forest lands such as timber harvest, mining and livestock operations.

Linear features (roads, trails and corridors) were the best matched activities across administrative boundaries as numeric parameters could more readily be attached to these types of features and most agencies had some sort of monitoring system in place to track use levels. The activity diagram developed for Yellowstone Park defined high use for motorized linear activities as receiving use "more than once per daylight hour" and low use as anything less than this. For non-motorized linear features, high use was defined as "used by more than 3 parties per day" and low use was anything less (USDI 1986).

With the "unification" of the CEM across the grizzly bear ecosystems, numeric parameters attached to linear features changed slightly. High use for motorized features was re-defined as "averaging 20 or more vehicular disturbances per week". "Vehicular disturbances" was the terminology adopted to account for multi-vehicle parties traveling through an area together, and thus treated as only one disturbance. Low motorized use was defined as "averaging between 3 and 19 vehicular disturbances per week", and a new category of *incidental* motorized use was developed to account for seldom used but open roads and trails as well as periodic administrative and/or illegal motorized use on closed roads. The use level for this category was defined as "averaging 2 or less vehicular disturbances per week" (USDA 1990).

Obviously, we do not have enough data on transportation systems within the ecosystem to accurately classify all roads and trails precisely into these categories. The

majority of the classification was based on mappers' intuition. However, agency

personnel with the best knowledge of road and trail use were consulted during the

mapping process, and numeric parameters greatly facilitated interpretation efforts.

Standardization of linear features across administrative boundaries was further

facilitated by a modeling project that parallels the CEM effort. The linear portion of the

CEM database was pulled out for a separate analysis of human access into grizzly bear

habitat for the purpose of evaluating high density access areas as well as identifying

potential security core areas (USDA/USDI 1994). The "Access" project calculates road

and trail densities in grizzly bear habitat regardless of habitat quality or other types of

activities; e.g. point and dispersed. This project resulted in the first attempt to edge match

any of the human activities data on an ecosystem-wide scale and required close scrutiny of

linear features that cross administrative boundaries.

Point activities were a bit more difficult to fit into standardized categories than

linear activities. However, they do not generally cross administrative boundaries so there

is no need to edge-match for geographic location of these features. The major

discrepancies in methods used to categorize point activities occurred in the distinction

between motorized and non-motorized point sources, and in the mapping and

classification of concentrations of point sources.

Early mapping efforts, and associated descriptions outlined in the Yellowstone

Park diagram for mapping activities (USDI 1986) considered most "developed" point

activities; i.e. those in close proximity to road networks, to be "motorized point sources".

Examples include developed campgrounds, houses and businesses such as hotels, stores

and gas stations. With the "unification" of the different grizzly bear models, it was jointly decided by all modeling teams that the road systems associated with these types of point sources represented the motorized activities, and that the point sources themselves should be coded as non-motorized. The only types of point activities that were considered motorized under the "unified" definitions were those that emitted large equipment noises; e.g. timber harvest activities, oil and gas drilling, mining and mill site activities (USDA 1990). Very few of the GYE agencies that had completed the activities mapping prior to establishment of the new definitions went back and revised their data.

The second major source of confusion with the mapping and classification of point activities was regarding concentrations of point sources; e.g. large developed campgrounds, ranch and lodge complexes, subdivisions and actual town sites. These types of point clusters did not fit well into the standard definitions. Obviously, it did not make sense to map every single residential and business structure in the city of West Yellowstone, but it was difficult to determine how many "points" were needed to simulate the impact of such an environment.

The mapping of major developments such as communities within the grizzly bear recovery zone had been addressed in various modeling team discussions and a recommendation was made to map these features as a single "point" and assign a large zone of influence and a high-impact disturbance coefficient to the site (zones of influence and disturbance coefficients will be discussed later in this document). In fact it has been noted by Mattson that evidence supporting the treatment of major developments as single point sources with large zones of influence comes from the most thorough data sets

available for reflecting human impacts on grizzly bears (Mattson et al. 1986). The

problem came down to the question of what constitutes a "major development". Some

places obviously fit into this category; e.g. communities inside the Park such as Mammoth,

Old Faithful, Lake, etc. and those outside the Park such as West Yellowstone, Gardiner,

Cooke City, etc. However, there were numerous situations where the fit into this

category was not as clear. Examples include large developed campgrounds both in the

Parks and in the National Forests, summer home areas, and large ranch and resort

complexes.

This dilemma has not been entirely resolved, but interim direction was developed

at a modeling team meeting in February 1995. Until a final resolution is reached, the

following standards are applied for mapping point sources in the GYE:

o   Single entity point sources are mapped as single point; e.g. back country campsites

o   A complex of structures and associated activities with a similar intensity and

      duration and all part of the same basic operation, such that effects (zone of

      influence) from all potential disturbance features can be represented by a single

      mapped point will be mapped as such; e.g. ranch complex, resort/lodge complex,

      ranger station, etc.

o   A complex of structures or activities with similar intensity and duration but

      geographically spread out such that multiple points (and zones of influence) are

      needed to represent the area of influence will be mapped with multiple points.

      Rather than mapping a point for each feature, fewer points shall be placed so that

      zones of influence generated for these points approximate the external boundary of

the complex while minimizing internal overlap of the zones of influence; e.g. summer home areas, employee housing, etc.

○ Major developments - it was decided to use one or a combination of the above criteria to map major developments (Dixon and Barber 1995).

Mapping of dispersed activities has been plagued by discrepancies between administrative units. Dispersed activities are by their nature, difficult to delineate on a map. It is also challenging to classify this type of activity as high or low use. The activities classification diagram developed in Yellowstone Park attempted to assign numeric parameters to dispersed use by defining high use as "more than one person per habitat component per day" and low use as less than this (USDI 1986). The major problem with using this break-down across the ecosystem is that habitat components as mapped in Yellowstone National Park; i.e. 10-acre mapping resolution at a scale of 1:62500, are generally much larger than habitat components mapped in the rest of the ecosystem; i.e. 5-acre mapping resolution at a scale of 1:24000.

In general, the modeling team has made the broad assumption that there is some degree of dispersed use almost everywhere in the ecosystem, but that only those situations associated with a known activity and level of use will be mapped for inclusion in the CEM database. It was also recognized that much dispersed use is associated with point and/or linear features and is accounted for in the zones of influence for these features. This type of dispersed use should not be mapped separately for use with the CEM. Examples include firewood and/or water gathering for use at a campsite, and nature photography or berry picking from a road (Dixon and Barber 1995).

Another complexity of classifying dispersed activities arose with the circumstance of multiple types of dispersed activities occurring simultaneously in the same place. An example would be an area where horn hunting coincides with a spring hunting season. The question was raised as to whether these activities should be mapped as separate features. Upon discussion of this situation, the modeling team agreed that for dispersed use, it is not appropriate to attempt to break-out concurrent activities in the same area.

Multiple "low use" activities in the same area could result in a polygon being coded as "high use", but basically dispersed use is a general category that does not identify specific activities. If motorized and non-motorized dispersed activities occur in an area simultaneously, the polygon is coded as motorized use to reflect the disturbance coefficient with the greatest impact. Descriptions in the attribute files can be used to track different activities without designating separate map features (Barber 1996).

In order to adequately address discrepancies in the mapping of human activities, it will be necessary to first consolidate all of the activities data for the ecosystem so that inconsistencies can be identified and resolved by the modeling team. This process has not yet occurred, as activities mapping for the Hellroaring/Bear and Boulder BMUs was not complete until September 1997. Now that activities mapping for the GYE CEM is complete, the next step is for administrative units to forward their "pieces" to the database coordinator and have all activity data combined for the entire ecosystem. The modeling team can then review and edit the data to increase accuracy and consistency. Examples of an activity map and associated attribute file are shown in Figure 9 and Table 1.

Figure 9: Human activities map. Feature attributes described in Table 1.

Activity ID	Description	Activity Code	Duration
PT001	hunting camp	P_NM_24	0915-1115
PT002	hunting camp	P_NM_24	0915-1115
PT003	outfitter camp	P_NM_24	0901-1130
PT004	back country cabin	P_NM_24	0701-0930
PT005	outfitter camp	P_NM_24	0901-1130
PT006	hunting camp	P_NM_24	0915-1115
PT007	picnic area	P_NM_D	0701-0930
PT008	outfitter camp	P_NM_24	0901-1130
PT009	hunting camp	P_NM_24	0915-1115
PT010	trailhead/picnic area	P_NM_D	0701-1130
LI001	trail	L_NM_H	0901-1130
LI002	road	L_M_H	0701-1130
LI003	trail	L_NM_H	0901-1130
LI004	road	L_M_H	0701-1130
LI005	road	L_M_L	0701-1115
LI006	trail	L_NM_L	0701-1115
LI007	trail	L_NM_H	0915-1115
LI008	trail	L_NM_H	0701-1115
DI001	dispersed hunting	D_NM_H	0901-1130
DI002	dispersed hunting	D_NM_L	0901-1130

Table 1: Human activities attributes for mapping example (Figure 9).

Data Maintenance and Updates

Mapping and attributing of all forms of data used with the CEM has been an ongoing process for many years. No set procedure has yet been established for updating data over time, as resources have been focused on *completing* data gathering for the GYE *before* endeavoring to develop an updating process. This aspect of database management will need to take a higher priority now that all areas within the grizzly bear recovery zone are completely mapped.

The establishment of a central database coordinator position with Ralene Maw at the Forest Service Regional Office in Ogden, Utah has greatly enhanced the abilities of the modeling team to deal with data issues. This position serves as a central repository and distribution point for all GYE CEM data. Map data are currently maintained in ArcInfo format, with activity attribute files attached as "Info items".

CHAPTER 3

THE MODEL

Now that the reader has a feel for the purpose and evolution of the CEM as well as the database upon which it runs, this section will focus on describing the actual model. This document will emphasize the conceptual design, quantitative relationships, model coefficients and output, over the actual technical operations of the CEM software. For more detailed information regarding the latter, consult the current GYE CEM manual: ICE9 User's Guide & Arm Chair Companion (Bevins 1997).

The conceptual design of the CEM is based on three critical elements of grizzly bear survival: habitat, disturbance and mortality. Habitat relates to the inherent capability of the GYE landscape to provide the resources necessary for grizzly bear survival and reproduction. Disturbance integrates human presence in grizzly bear habitat and how that presence reduces the overall effectiveness of habitat relative to grizzly bear use patterns. Mortality as considered in the CEM corresponds to human-caused grizzly bear deaths and a method for quantifying the risk of bear mortalities associated with human activities.

To assess the relationships of these elements in the GYE the CEM was originally designed with three routines to address factors related to habitat, disturbance and mortality. Figure 10 shows a diagram of model routines. Rule sets were developed for

Figure 10: Diagram of GYE CEM routines.

each routine to bridge the gap between the conceptual model and the computer programs. These rule sets facilitate the conversion of spacial and temporal ecological relationships into mathematical functions. Results generated from the three routines are integrated to predict relative measures of habitat value, habitat effectiveness and mortality risk throughout the ecosystem. It should first be noted that currently only the habitat and disturbance routines are being used in the GYE. The mortality routine, and reasons for abandoning the original version will be discussed in detail later in the document.

Habitat Routine

The habitat routine quantifies the value of grizzly bear habitat based on vegetative composition of the landscape and the presence of protein-rich animal food sources, as represented by the vegetative and supplemental habitat maps. The habitat routine culminates in a numeric figure expressed as *Habitat Value (HV)*. HV is a relative measure of a particular area's contribution to grizzly bear habitat and incorporates factors such as vegetative and animal food sources, security cover, and density of preferred (i.e. forest - nonforest) edges. The following assumptions apply to the habitat routine: (USDA 1985)

1. Habitat quality, independent of human impact, is primarily a function of the availability of food and cover.

2. In the absence of human impact, food availability outweighs the contribution of cover to habitat value indices.

3. Grizzly bear use data collected by the IGBST are representative of use patterns for the entire GYE grizzly bear population.

4.   The habitat-cover type combination as mapped for vegetative habitat is an accurate predictor of food and cover quality and availability in the GYE.

5.   Overall habitat value is accurately predicted by the combination of vegetative composition of an area and availability of animal food sources (USDA 1990).

Numeric values are assigned to habitat components in the form of model *coefficients*. The coefficients invoked in the habitat routine include values for vegetation, edge and supplemental habitat components, each of which will be described in turn. The original sets of habitat coefficients were derived by Mattson early in the development of the CEM and have been modified by he and others over time.

Vegetation Coefficients

Vegetation coefficients constitute the numeric representation of foraging opportunities and security cover available to bears on a seasonal basis. A detailed account of the process used to develop the vegetation coefficients was presented by Mattson et al. (1985). This description is highly technical and complex, making it difficult to understand by the average biologist or manager. In June 1997 Mattson described and demonstrated the process used to derive vegetation coefficients at a modeling team meeting. The following explanation synthesizes input from the meeting and the written description (Mattson et al. 1985).

Radio relocations of collared grizzly bears were used by the IGBST to examine feeding sites and collect scats. At each feeding site the date, feeding activities, and prevailing habitat and cover types were recorded. Vegetation coefficients were derived

through a rigorous analysis of these data collected between 1977 and 1983. Data were pooled for all sex and age cohorts to increase sample size. The separate habitat and cover type vegetative maps produced for Yellowstone National Park provided summary statistics by vegetative component area (Mattson et al. 1985).

The intent behind the vegetation coefficient derivation process was to reflect the degree of energy expended relative to energy gained for various feeding activities by vegetative type and by season. Four main factors were considered in the analysis to determine vegetation coefficients:

1. food value (FV) associated with the feeding activities recorded for each feed site

2. proportionate representation (PR) of feeding activities relative to vegetative types sampled

3. bear preference (BP) or relative density of feeding activities in each vegetative type, and

4. habitat diversity index (DI) by vegetative type and season (Mattson pers. comm.).

Food Value. A food value (FV) was assigned to each feeding activity by feed site and by season. A literature search was conducted to determine the amount of digested energy (kcal/gram) obtained from each food source known to be used by grizzly bears in the GYE. A survey was conducted of area grizzly bear researchers and experienced field personnel to rank all food items on a scale of 1 to 4 based on the amount of digested energy gained per volume of bite taken. A rank of 1 indicated a relatively small amount of energy gained per bite, as would be obtained by grazing on grasses, whereas a rank of 4

indicated a relatively large amount of energy gained per bite, such as feeding on ungulate

carcasses (Mattson pers. comm.)

A similar subjective ranking system was used to categorize the amount of energy

expenditure required to obtain various food types. These values also ranged from 1 to 4

with 1 being relatively little energy required per bite of food; e.g. grazing on plentiful

vegetation, and 4 indicating relatively large amounts of energy required per bite; e.g.

excavation of rodents. The "rank gained" less the "rank lost" figure then became the "bite

rank". This figure was multiplied by the digested energy (DE = kcal/gram) rate

determined from the literature to come up with a rating of energetic efficiency (EE) for

each feeding activity: (Mattson pers. comm.)

$$EE = Bite_{rank} * DE$$

Scat analysis was used to determine the frequency of each diet item per volume of

fecal material (VF). An aggregation factor (AF), a subjective measure, was used to

reflect the degree to which food items were concentrated within a feed site; e.g. an

ungulate carcass would have a greater aggregation factor than a dispersed patch of berries.

A final factor figured into the food value score was a measure of the consistency with

which food items were used from one year to the next. The inverse of the coefficient of

variation (1 - CV) was used to reflect the interannual use variation of each diet item,

imparting less value to food items used irregularly relative to those consistently used

between years. Thus the food value score (FV) was calculated:

$$FV = EE * (VF + AF) * (1 - CV)$$

Proportionate Use. The proportionate use (PR) of each vegetation type was determined by building a matrix of vegetative habitat types (habitat/cover type combinations) and food items or feeding activities for each season. The matrix was used to determine the number of times a specific food item was utilized or a particular feeding activity occurred within the various vegetative habitat types. The intent was to calculate the proportion of use of each vegetative habitat type, whether it was used for feeding on plant foods or animal carcasses or both (Mattson pers. comm.) Table 2 shows a greatly simplified example of the proportionate use matrix.

	FA1	FA2	FA3	FA4	FA5	FA6	FA$_j$	Total	Prop.
H/C1	5	5	0	0	0	10	...	20	.20
H/C2	0	10	0	0	0	0	...	10	.10
H/C3	2	15	5	8	0	0	...	30	.30
H/C4	3	17	13	4	1	2	...	40	.40
:									
H/C$_j$									
Total	10	47	18	12	1	12		100	

where H/C1 might be 82053 (Abla/Pial-Vasc HT w/ CT WB3) and
      FA1   "   " feeding on grouse whortleberries (*Vaccinium scoparium*)
      FA2   "   " digging for pocket gopher (*Thomomys talpoides*)
      FA3   "   " feeding on ungulate carcass
      FA4   "   " digging for yampa (*Perideridia gairdneri*) roots
      FA5   "   " digging for insects
      FA6   "   " feeding on whitebark pine (*Pinus albicaulis*) seeds

Table 2: Example of matrix used in calculations of proportionate use (PR) and bear preference (BP)

Bear Preference. A bear preference factor (BP) was also figured into the vegetation coefficients as a measure of the relative frequency of use of different vegetative components for various feeding activities; i.e. the density of use of any particular habitat/cover type for foraging purposes. This factor was determined on a use-availability basis by taking the natural log of 1 plus the observed use divided by expected use. The natural logarithmic transformation was used to adjust the preference factor to account for sensitivity to small sample size (Mattson et al. 1985).

Observed use was the proportion of a particular diet item in one vegetative component (habitat/cover type) out of the total for that feeding activity over all vegetative types. Expected use was the proportion of all feeding activities in a particular vegetative component out of all feeding activities over all vegetative types. Using the numbers in Table 2 as an example, feeding activity FA1 occurred 5 times in habitat/cover type H/C1 out of 10 total occurrences of FA1 over all H/Cs, so observed use is: (5/10 = .5). With 100 total FAs over all H/Cs, the expected use then becomes: (20/100 = .2). So the BP factor is: ln (1 + .2/.5) = 0.336 (Mattson pers. comm.)

Diversity Index. The final factor used in the vegetation coefficient derivation formula was a diversity index (DI). This factor was used to reflect the enhanced value to grizzly bears from vegetative components with greater structural and compositional diversity. Those types with greater diversity were considered to provide increased probability of feeding opportunity; particularly given the annual fluctuation in availability of food items for grizzlies in the GYE (Mattson et al. 1985). The Shannon/Weaver (1963)

index was used to approximate the relationship between habitat diversity and foraging opportunities .

In summary, the vegetation coefficients were derived by incorporating factors of food value for each vegetative component (FV), proportionate representation of vegetative components in foraging activities (PR), bear preference or relative density of feeding activities by vegetative component (BP) and habitat diversity of each vegetative component (DI). The formula used to calculate vegetation coefficients is as follows:

$$VC_{jku} = ((\sum FV_{ik} * PR_{ijk} * BP_{ijk}) * DI_{jk})$$

Variables:

VC_{jku} = vegetation coefficient for habitat type 'j' during season 'k' in ungulate strata 'u'

FV_{ik} = food value for feeding activity 'i' during season 'k'

PR_{ijk} = proportionate representation of feeding activity 'i' in habitat type 'j' during season 'k'

BP_{ijk} = bear preference or relative density of feeding activity 'i' in habitat type 'j' during season 'k'

DI_{jk} = diversity index for habitat type 'j' during season 'k' (Mattson et al. 1985)

Coefficients were assigned to vegetative components on a seasonal basis; i.e. each habitat/cover type combination has a value for spring (March through May), summer (June through August) and fall (September through November). Vegetative coefficients were further stratified by the presence or absence of ungulate concentrations. Bear management subunits that met the criteria of having ungulate densities of at least 10 bison per 100 km^2 or at least 250 elk per 100 km^2 were assigned "with ungulates" vegetation

coefficients. Subunits that did not meet these minimum ungulate concentration levels were assigned "without ungulate" vegetation coefficients (Mattson pers. comm.)

The distinction was made between "with" and "without" ungulate vegetation coefficients because the analysis of feeding activities data indicated that the presence or absence of ungulates influenced the way bears were using all food sources (plant and animal matter) within any particular vegetative component type. The "without ungulate vegetation coefficients" were calculated by removing all ungulate carcass feeding activities from the matrix (Mattson pers. comm.) This distinction between "with" and "without" ungulate vegetation coefficients is not to be confused with the value added factor for habitat components with the application of supplemental coefficients to be discussed later.

Based on the above considerations, each habitat/cover type combination of vegetative habitat components mapped in the GYE (including nonforest types) has six vegetation coefficients in the CEM parameter files (three seasons * two ungulate conditions). Vegetation coefficients used with the ICE9 version of the GYE CEM software are listed in Appendix B.

At the modeling team meeting in June 1997 Mattson reiterated his opinion that the initial development of the model coefficients (as well as the model in general) was primarily a conceptual approach. The intent was to develop a prototype that could be used to assess habitat value for grizzly bears. He viewed the initial effort as a "first-cut" at producing model coefficients that would be tested, revised and updated over time. The demand for a working model was strong and implementation occurred very quickly. The vast majority of resources was focused on data collection and software development, with

little attention devoted to review and revision of model coefficients based on model results, new data, new methodologies, etc.

With development of the "unified" (across all grizzly bear ecosystems) CEM came the impetus to revise vegetation coefficients in the GYE using additional data; i.e. feed site and scat data from 1984 through 1988 and vegetation mapping from National Forests and Grand Teton National Park. This task was assigned to Mattson who proposed a slightly different analysis technique that would result in vegetation coefficients stratified by quality of food year as follows:

worst case 1 — poor food year using data for adult females only

worst case 2 — poor food year using data for all bears

best case — good year for whitebark pine nuts

average — average data for above conditions

This effort was initiated late in 1988 but for reasons of budget shortfalls and time limitations the analysis to revise coefficients was never completed.

Subsequent modifications to the original coefficient files did occur, but rather than assessing the entire list of vegetation coefficients, the changes made over time have been in the form of additions to fill the gaps resulting from the initial effort. At the time of the original development of vegetation coefficients for the CEM the only vegetative habitat component maps available were those produced for Yellowstone National Park. Consequently, as attempts were made to run the CEM for analyses of National Forest lands; e.g. Targhee, Bridger-Teton and Gallatin, numerous vegetative component codes were encountered for which there were no existing model coefficients. Initial efforts at

filling the gaps in the vegetation coefficient files ranged from agency personnel contacting Dave Mattson and asking him to provide the necessary information, to simply filling in all the missing values with the lowest possible vegetation coefficient of 0.0001 for all seasons and both "ungulate conditions".

In 1993 Mattson was asked to fill in some of the gaps existing in the original coefficient tables presented in Tables 3-6 of the Appendix in the "Blue Book" (USDA 1985). Any vegetative component types that had blanks or "???" in these tables were assigned the same coefficients as similar vegetative types based on species composition, moisture regime and structural characteristics associated with the various habitat and cover types. The blanks that occurred in the original tables were due to a lack of empirical data from scat and feed site data for those particular vegetative component types.

A breakthrough in the process for completing the vegetation coefficient files came with the update of the vegetative habitat component maps after the 1988 fires. One product of the fire update was a comprehensive list of all the vegetative component codes occurring in the prefire base maps produced for the GYE. In 1994, I took this list and compared it to the most current version of the vegetation coefficient files. After adjustments were made for obvious coding errors, a new list was made of all mapped vegetative habitat component codes for which there were currently no model coefficients. This list was forwarded to Mattson, who then notations as to which vegetative types the coefficients should be extrapolated from, following the process he used for filling in the gaps in the "Blue Book" tables as discussed above. These notations were then used to fill in the blanks for all remaining codes.

The Habitat Routine of the CEM uses vegetation coefficients in the calculations of habitat value (HV). Habitat value is a measure of the seasonal and annual quality of an area based on vegetative characteristics and associated foraging opportunities. Habitat value is determined by building upon the base value contributed by vegetation coefficients and increasing the value of those areas associated with preferred edges and/or supplemental habitat components. HV is determined on a seasonal basis by summing over all vegetative habitat components the weighted average vegetation coefficients multiplied by the total acres for each vegetative component type over all days in the season. These figures are then adjusted for contribution of edge and supplemental habitat components. Annual HV is merely the total of seasonal HVs.

The ICE9 software accomplishes this task by breaking down, or rasterizing, all base maps into 5-acre cells. The 5-acre cell size was selected in accordance with the minimum mapping resolution for vegetation in the GYE. Each cell is assigned the vegetative component code of the original mapped polygon. Cells that contain parts of more than one vegetation polygon from the original map are assigned the code of the polygon which covers the center point of the cell. Vegetation value is accumulated as the weighted average vegetation coefficient over all cells over all days in each season. The weighted average is used to account for vegetative components coded as mosaics. Recall that mosaics have more than one vegetative component and are thus assigned multiple vegetation codes.

Each cell may have from 1 to 4 codes assigned. Vegetation coefficients are applied in a weighted manner based on the order of appearance of the vegetation codes.

In the case of mosaics the codes are listed in the order of dominance within the mapped polygon. For example, a polygon that is primarily forested habitat with interspersions of open meadow may have the following vegetation code: 7323300033; where 73233 represents the forested component and 00033 represents the meadow component. Weighting factors (Bevins 1997) for vegetation components areas follows:

> 1 vegetation code = 4/4 = 1
>
> 2 vegetation codes = 4/7 ($\approx$.5714) and 3/7 ($\approx$.4286)
>
> 3 vegetation codes = 4/9 ($\approx$.4444), 3/9 ($\approx$.3333) and 2/9 ($\approx$.2222)
>
> 4 vegetation codes = 4/10 (=.4), 3/10 (=.3), 2/10 (=.2) and 1/10 (=.1)

Determining the weighted average vegetation coefficient for the mosaic example given above would use the following logic. For spring, the "with ungulate" coefficient for the forested habitat component 73233 is .057. The spring, "with ungulate" coefficient for the meadow component 00033 is .474. The weighted average coefficient for this mosaic in spring using the "with ungulate" coefficients is (.5714*.057)+(.4286*.474) = .236. This same logic would apply for all seasons and for both ungulate strata. The coefficient is multiplied by cell size (5 acres) to account for area representation of mapped vegetation types, which results in a daily vegetation value for each cell. The model will then make adjustments for edge density and supplemental habitat components.

Edge Coefficients

Grizzly bears in the GYE are known to show a preference for ecotones associated with forest - nonforest edge (Graham 1978, Blanchard 1983, Brannon 1984, Schleyer et al

1984). To account for this preference, edge coefficients are applied to portions of vegetative components within 150 meters of a forest - nonforest edge.

Edge coefficients were also developed by Mattson using essentially the same data sets as the vegetation coefficients; i.e. 1977 - 1983 feed site data and separate habitat and cover type maps for Yellowstone National Park. Coefficients were derived for each season based on the frequency of foraging activities within 150 meters of forest - nonforest edge. Vegetation maps were used to estimate the proportion of the landscape in Yellowstone National Park within 150 meters of the preferred edge types. Feed site locations were used to determine the frequency with which bears were foraging within these ecotones (Mattson pers. comm.)

To demonstrate, following is an explanation of the process used to determine the edge factor for use of nonforest habitats within 150 meters of forest habitat in spring. It was estimated that 65 percent of the nonforest habitat components within Yellowstone National Park were within 150 meters of forested habitat components, leaving 35 percent of the nonforest habitat at a distance greater than 150 meters from a forested component. Feed site data indicated that 97 percent of the spring foraging activity in nonforest habitats occurred within 150 meters of a forested habitat component, with only 3 percent of this foraging behavior evident beyond 150 meters of the edge. Use/availability ratios were calculated as follows:

Within 150 meters of edge use/availability: 97/65 = 1.49

Beyond 150 meters of edge use/availability: 3/35 = .085

These figures were then used to determine that the odds of a bear feeding in nonforest

habitat within 150 meters of forested habitat in spring were 1.49/.085 or 17.5 times greater than the odds of a bear feeding in nonforest habitat beyond 150 meters of a forest edge. Thus, 17.5 became the spring edge coefficient for nonforest habitat components within 150 meters of forest edge (Mattson, pers. comm.)

At the time of the original coefficient development, edge coefficients were derived for both "natural" and "created" edges. "Natural" edges were considered to be ecotones between naturally forested components which provide cover and natural meadows or openings. "Created" edges described the condition between naturally forested components which provide cover and naturally forested components from which cover has been removed either by fire or through timber harvest. Coefficients for "created" edges were roughly one half the value of "natural" edge coefficients (USDA 1985)

This condition became a point of concern when initial model runs were indicating timber harvest units to be of inordinately high value to grizzly bears. Recognizing that the coefficients were based on limited data, a review of the literature regarding grizzly bear use of edge (Blanchard 1983) revealed support only for the "natural" ecotones to receive the edge factor. Thus, the model was revised to apply the edge coefficient only to "natural" edges.

The CEM determines edge by a special cover type code assigned internally by the software to all vegetation habitat component codes. Rather than presenting the details of how the model assigns cover type codes and edge coefficients, the process will be described conceptually. Each vegetative component type has a unique 5-digit numeric code. Recall that forested components are coded by habitat type (Pfister et al. 1977,

Steele et al. 1983) and cover type (Mattson and Despain 1985) and that nonforest codes always begin with "000".

Basically, any cell with a vegetation code that begins with "000" next to at least one cell with a vegetation code that begins with other than "000" receives the *nonforest* edge coefficient. Likewise any cell with a forested vegetation code next to at least one cell with a nonforest code receives the *forest* edge coefficient. The exception is the case of a forest habitat type with a cover type code indicating that the overstory has recently been removed through harvest or natural disturbance. These vegetative types were associated with the "created" edge type described earlier and currently do not constitute any "edge" condition regardless of what their neighbor cells are coded.

The 5-acre cell size is very convenient for application of edge coefficients as the distance across a 5-acre cell is approximately 142.25 meters. Applying edge coefficients on a cell-by-cell basis then closely approximates the 150 meter edge zone for bear preference as supported by the literature (Blanchard 1983). All cells with mosaic codes of forest - nonforest combinations receive the edge coefficient of the predominant type. Single vegetative type cells adjacent to mosaics will receive the edge coefficient if the predominant type of the mosaic is the complementary edge type of the single code cell (Bevins pers. comm.)

The process used to derive edge coefficients produced large numbers relative to most habitat coefficients. This condition has raised some concern as edge coefficients are used as multipliers by the habitat routine in the calculation of habitat value, resulting in dramatic increases in habitat value along forest - nonforest edge. Acknowledging that

edge coefficients were based on limited data, Mattson proposed a revision of edge coefficients in 1988 including more recent data. Like the effort to update vegetation coefficients at that time, the edge coefficient revision also became victim to budget and time limitations and was never brought to fruition.

At the modeling team meeting in June 1997, Mattson indicated that he has conducted additional research regarding grizzly bear use of forest - nonforest ecotones in the GYE. This work emphasized bear use of biscuitroot (*Lomatium cous*) (Mattson 1997) and ungulate carcasses (Mattson 1996). Results of these studies suggest that the edge coefficients as originally calculated for use with the CEM are probably high. Based on this more recent work, Mattson has suggested that an edge coefficient of 2 would be more appropriate for all seasons and for both forest and nonforest components alike. This new edge coefficient has yet to be officially adopted by the modeling team, although approval seems imminent. Edge coefficients in use with the GYE CEM as of October 1997 are listed in Appendix B.

Supplemental Coefficients

The final variable factored into the habitat value equation reflects the value added to grizzly bear habitat by supplemental habitat components. Recall that supplemental components are those which further enhance the quality of habitat beyond the inherent value provided by virtue of an area's vegetative composition and structure. Currently, only those supplemental features that provide protein-rich food sources for grizzly bears are included in the model; e.g. ungulates, fish and insects. Supplemental habitat

components, like vegetative components, may occur with more than one type in the same geographic location (or polygon on a map). Unlike the vegetation mosaics however, when multiple supplemental component codes occur in a polygon label, only the coefficient with the highest value is applied.

Supplemental coefficients are the numeric representation of the contribution of these features to habitat value. The coefficients were developed by Mattson at least partly to account for discrepancies revealed by application of vegetation coefficients alone. He compared known bear densities (i.e. density index derived from bear location data) for each BMU to habitat productivity scores calculated from vegetation coefficients. Once again the data sets used for the analysis were limited to Yellowstone National Park.

Preliminary results showed a strong correlation (R^2 = .92) between adult female density and vegetative habitat productivity scores. However, upon further analysis Mattson determined that the deviations where observed use was greater than expected could be attributed to the availability of supplemental food sources not explicitly identified in the vegetative habitat components and associated coefficients (Mattson pers. comm.)

The supplemental protein sources identified in the analysis were primarily attributed to winter killed and weakened ungulates. Supplemental coefficients for bear use of ungulates were assigned based on the correlation to vegetative habitat productivity scores (Mattson pers. comm). Certain types of winter range; e.g. moose, bison and elk at low elevation, that did not show a correlation with vegetative habitat productivity scores, but were known to be used by bears as occasional concentrated energy sources, were assigned coefficients of 1. Supplemental coefficients are used as multipliers in the habitat

routine's calculation of habitat value, so a coefficient of 1 does not influence habitat value, but provides a method of tracking these potential high energy sources until such time as data support a coefficient other than 1.

At the time he was developing supplemental coefficients for bear use of ungulates (1985), Mattson also recognized another critical high energy source for GYE grizzlies with the use of fish spawning streams. In the late 1980s, yet another high energy source, insect aggregation sites (primarily army cutworm moths), became evident. Derivation of fish and moth supplemental coefficients was based on a use/availability analysis, using bear location data compared to random points. Results from this analysis indicated that bear use was 19.2 times greater than expected within 500 meters of moth aggregation sites, and 2.5 times greater than expected within 2 km of fish spawning streams (Mattson 1993b). Therefore, these figures were incorporated into the CEM as the supplemental coefficients for moths and fish .

Supplemental coefficients are typically applied by the habitat routine as multipliers against the base value of the vegetative components occurring in the same geographic locations; i.e. at the cell level. However, for moth and fish supplemental habitat coefficients, the data and the analysis were organized differently so that the base vegetative value against which these coefficients are applied is the average vegetation coefficient value for the subunits in which these types occur. (Mattson 1993b).

Application of moth and fish coefficients in this manner would take considerable re-programming of the CEM software to accommodate a few scattered sites in the GYE. Instead, Kim Barber calculated the average subunit vegetation value for the known moth

feeding sites. This value was added to the list of vegetation coefficients with a special 5-digit vegetation code. The vegetative habitat components underlying the moth supplemental polygons were re-mapped using the new code so that the old vegetative values are now superseded with the new vegetation coefficient value equivalent to the subunit average.

A similar exercise was conducted for fish spawning sites. Results indicated that the existing vegetative values underlying the fish supplemental polygons were close to the average values for the subunits in which they are located, so the vegetative habitat components were left as originally mapped. A complete list of supplemental coefficients currently used in the GYE CEM are found in Appendix B.

In summary, the habitat routine applies vegetation, edge and supplemental coefficients to mapped vegetative and supplemental habitat features on a 5-acre cell basis, for each day in a season, to determine habitat value (HV) for an analysis area, generally a BMU or subunit. The formula for calculating seasonal habitat value is as follows:

$$HV_{AS} = \sum_{c=1}^{n_c} \sum_{d=1}^{n_{sd}} [(\text{weighted } VC_{hsu} * CellAcres) * EC_{ts} * SC_{ps}]$$

Variables:

HV_{AS} = the habitat value (HV) for analysis area 'A' in season 'S'

n_c = the number of cells in the analysis area

n_{sd} = the number of days in the season

VC_{hsu} = the vegetation coefficient for habitat type 'h' in season 's' by ungulate strata 'u'

EC_{ts} = the edge coefficient for cover type 't' in season 's'

SC_{ps} = the supplemental coefficient for protein type 'p' in season 's'

A simple example of habitat value computation is presented in Figure 10 and Table 3.

Disturbance Routine

The disturbance routine is where human impacts are considered. The objective behind this routine is to quantify the effects of human activities in order to provide managers with a measure of human caused impairment of grizzly bear habitat. Humans can impact grizzly bears and their habitat in three primary ways: 1) permanent and temporary alteration of the habitat, 2) actual displacement of some or all of the grizzly bears in an area, and 3) alteration of use patterns resulting in an overall reduction of time available for bears to use an area (USDA 1990).

Although human manipulation of vegetation through timber harvest, prescribed burning, planting of crops and development is certainly recognized as a form of disturbance, the effects of such alterations are evaluated by the habitat routine. Base maps represent *existing* vegetative conditions, including patterns resulting from human practices such as timber harvest, agriculture and pavement. The CEM will accept several "layers" of vegetation base maps. Information on new layers supercedes the data from previous layers where the two overlap. In this way managers can evaluate the effects of man-caused and natural changes in vegetative quality by examining changes in habitat value (HV) outputs over time.

Just as habitat alterations are evaluated by the habitat routine, grizzly bear displacement and disruption of use patterns due to human activities, are assessed by the

81

Fall Season: Sept. 1 - Nov. 30 (91 days)

1 cell = 5 acres

Total Habitat Value = 206,252 HUD

Figure 11: Graphic example of habitat value (HV) computations.

Code	Description	Calculation	Total HUD
72033	no edge	90 x 5 x .6 x 91	24,570
72033	with edge	10 x 5 x .6 x 8 x 91	21,840
00073	with edge	19 x 5 x .5 x 6 x 91	25,935
00073	no edge	81 x 5 x .5 x 91	18,428
82053	no edge	166 x 5 x .9 x 91	67,977
82053	edge	10 x 5 x .9 x 8 x 91	32,760
82053	with US	24 x 5 x .9 x 1.5 x 91	14,742

(Habitat Unit Days = HUD)   **Total HV = 206,252 HUD**

Table 3: Sample mathematic calculations for HV.

disturbance routine. Very simply put, the disturbance routine detracts from habitat value for all types of human activities occurring in grizzly bear habitat on a seasonal and annual basis. The result is expressed as *Habitat Effectiveness (HE)* which is essentially a numeric representation of an area's actual ability to support grizzly bear use; i.e. a measure of carrying capacity (USDA 1990).

The disturbance routine operates in a similar manner to the habitat routine, in that human activities base maps are also rasterized, or divided into 5-acre cells, and coefficients are applied through mathematical equations at the cell level. The conceptual design of the disturbance routine was based on the following assumptions: (USDA 1990)

1. Grizzly bears are sensitive to disturbance from human activities

2. Grizzly bears respond to human disturbance by altering normal spatial and temporal use patterns in a manner reflected by disturbance coefficients.

3. Disturbance from human activities has a greater impact in open areas than in forested areas which provide cover.

4. Habituation and other factors that may influence grizzly bear response patterns are adequately reflected in disturbance coefficients.

5. Disturbance effects from spatially and temporally overlapping human activities accumulate in a multiplicative manner.

Zones of Influence

As mentioned in the database discussion, human activities were mapped and categorized according to their disturbance potential. Point and linear activities were

mapped to specific locations, but early CEM developers recognized that the disturbance

effect from these activities extends beyond the point or line drawn on a map. Therefore the concept of zones of influence (ZOI) emerged through the modeling process to account for the extended impact from point and linear activity features. Figure 11 shows an example of zones of influence.

Figure 12: Zones of influence for point and linear activities.

The ZOI is internally generated for point and linear features by the CEM software. Dispersed activities do not require computer generated ZOIs as they are represented by polygons which define the ZOI for the activity (or activities) mapped (USDA 1990).

Based on the assumption that human activities have greater impact in open areas than in habitats which provide cover, the CEM originally varied the size of the ZOI so that the same activity would have a larger ZOI in nonforest habitat than in forested habitat. Under this scenario, motorized point and linear activities had a 2 mile ZOI in open areas.

In areas with forest cover, motorized linear activities had a .5 mile ZOI and motorized point activities had a 1 mile ZOI (USDA 1985).

Non-motorized point and linear activities had a .5 mile ZOI in open areas. In areas with cover, non-motorized linear activities had a .1 mile ZOI and point activities a .3 mile ZOI. Disturbance coefficients for each activity class were the same in both cover and non-cover conditions and the variable ZOI accounted for the differential impact (USDA 1985). This method of calculating disturbance impacts proved very costly in terms of computer time and space requirements.

With the re-programming of CEM software for the "unified" version the modeling team proposed a change to fixed ZOI (.5 mile for motorized and .25 mile for non-motorized activities regardless of cover conditions) and variable disturbance coefficients to represent contrast between cover and non-cover habitats. Collin Bevins scaled the existing disturbance coefficients for testing the case of fixed ZOIs. He used data from two GYE quad maps, one "busy" (177 activity features) and one "light" (9 activity features) to test the fixed vs. variable ZOI concepts (Bevins 1989).

Results for the busy quad showed a 13% change in model output between the variable and fixed ZOI, with the variable method resulting in overall greater habitat reductions. The lighter activity quad showed greater disparity in output (5.7% habitat reduction with variable ZOI and fixed disturbance coefficients vs a 9.2% reduction with fixed ZOI and variable disturbance coefficients). This quad contained only motorized activities so just the .5 mile fixed ZOI was used. With fewer activities the fixed ZOI method resulted in greater habitat reductions than the variable method (Bevins 1989).

Both test quads revealed significant differences in computer processing time and data storage requirements. The fixed ZOI method resulted in approximately a 67% reduction in computation time and roughly a 50% reduction in storage space requirement (Bevins 1989). The modeling team decided that the savings obtained by the fixed ZOI method outweighed the costs and Bevins was contracted to make the change in the new version of software developed for the "unified" version of the CEM.

As the new software was being developed and tested, Mattson was asked to revise the CEM disturbance coefficients based on the fixed ZOI concept. New disturbance coefficients were developed for forested habitat components, nonforested components and forest - nonforest mosaics. This revision occurred in February 1991 and the new coefficients were included in the CEM parameter files. The model uses the same cover-type code used to determine edge values in the habitat routine to distinguish cover and non-cover conditions for application of disturbance coefficients. Current disturbance coefficients and ZOI are listed in Appendix B.

Disturbance Coefficients

Disturbance coefficients (DC) were originally developed in 1985 using the best judgement of biologists and modelers on the technical committee. These coefficients were used with the variable ZOI method. When Mattson updated the disturbance coefficients for use with the fixed ZOI method, he used data from more recent studies of the effects of human activities on bears. Results from these studies were used to identify habitat reduction factors and zones of influence associated with various activity types (Mattson

pers. comm.) The modeling team has asked Mattson to document the process for this effort and cite the specific studies used in the analysis.

Disturbance coefficients are rated on a scale of 0 to 1. A disturbance coefficient of 0 represents total displacement or disruption of bear use patterns within the ZOI such that the habitat is effectively rendered useless to bears for the duration of the activity. Conversely, a disturbance coefficient of 1 basically represents no disturbance at all. Disturbance coefficients are used as multipliers against habitat value (HV) in the disturbance routine to determine habitat effectiveness (HE). For example, an activity with a disturbance coefficient of .7 reduces the habitat effectiveness within the ZOI by 30%, i.e. results in 70% habitat effectiveness (HE) score relative to inherent habitat value (HV).

Zones of influence will overlap when activities are in close proximity. Based on the assumption that bears are sensitive to disturbance from multiple human activities, overlapping ZOIs are considered to produce cumulative impacts (USDA 1990). In order to model this effect, disturbance coefficients of overlapping ZOIs (where the activities occur simultaneously) are treated in a multiplicative manner. This method was chosen as the modeling team felt that using the greatest impact coefficient did not adequately reflect the cumulative impacts from overlapping activities. Treating the coefficients in an additive manner has an opposite effect of the desired results as adding the coefficients together would increase their value and have the effect of inflating habitat effectiveness scores. In fact if enough activities occur together, the addition of disturbance coefficients would quickly produce habitat effectiveness scores that are *greater* than the habitat value scores. By multiplying disturbance coefficients together for overlapping activities the numbers

become smaller and smaller resulting in larger *reductions* in habitat effectiveness scores, which is the desired outcome.

The disturbance routine evaluates activities occurring at each cell in the analysis area on a daily basis. When multiple activities occur on the same cell (overlapping ZOI) on the same day their disturbance coefficients are multiplied together and the result is multiplied against the underlying habitat value score. The model determines the spacial relationship of activities by their locations on base maps, and subsequent cell locations. Temporal relationships are determined from activity duration information contained in the activity attribute files which accompany the base maps. Disturbance coefficients to be applied are determined by a combination of the cover-type code referenced from the vegetative base maps and the activity classification code from the activity attribute file.

In summary, the disturbance routine calculates a daily habitat effectiveness (HE) score for each cell in an analysis area (typically a BMU) by multiplying the daily habitat value (HV) score by the cumulative disturbance coefficients. The daily HE scores are then summed over all cells in the analysis area for all days in the season using the following formula:

$$HE_{AS} = \sum_{c=1}^{n_c} \sum_{d=1}^{n_{sd}} [HV * (DC_{a1t} * DC_{a2t}... * DC_{ant})]$$

where $DC_{a1t}...{}_{ant}$ represent impacts in cover type 't' from all activities influencing the cell. Figure 12 and Table 4 demonstrate simple habitat effectiveness calculations.

Fall Season: Sept. 1 - Nov. 30 (91 days)

1 cell = 5 acres

— — — — Trail: L_NM_H 7/1-10/31; DC = .7 (F) .6 (NF)
✠ Camp: P_NM_24 7/1-10/31; DC = .6 (F) .3 (NF)

Total Habitat Effectiveness Value = 184,245 HUD
Net decrease = 22,007 HUD (-10.67% change)

Figure 13: Graphic example of habitat effectiveness (HE) computations. See Table 4 for mathematic calculations.

Code	Description	Calculation	Total HUD
72033	no edge, no ZOI	18 x 5 x .6 x 91	4.914
72033	single trail ZOI	32 x 5 x .6 x 61 x .7 +32 x 5 x .6 x 30	6,979
72033	double trail ZOI	36 x 5 x .6 x 61 x .7 x .7 + 36 x 5 x .6 x 30	6.468
72033	trail + camp ZOI	4 x 5 x .6 x 61 x .7 x .6 + 4 x 5 x .6 x 30	668
72033	trail, camp, edge	6 x 5 x .6 x 8 x 61 x .7 x .6 + 6 x 5 x .6 x 8 x 30	8,009
72033	edge, no ZOI	4 x 5 x .6 x 8 x 91	8,736
00073	edge, no ZOI	13 x 5 x .5 x 6 x 91	17, 745
00073	trail, camp, edge	6 x 5 x .5 x 6 x 61 x .3 x .6 + 6 x 5 x .5 x 6 x 30	3, 688
00073	trail + camp ZOI	12 x 5 x .5 x 61 x .3 x .6 + 12 x 5 x .5 x 30	1,229
00073	camp ZOI	4 x 5 x .5 x 61 x .3 + 4 x 5 x .5 x 30	483
00073	no edge, no ZOI	65 x 5 x .5 x 91	14, 788
82053	no edge, no ZOI	106 x 5 x .9 x 91	43, 407
82053	single trail ZOI	60 x 5 x .9 x 61 x .7 + 60 x 5 x .9 x 30	19,629
82053	edge, no ZOI	10 x 5 x .9 x 8 x 91	32.760
82053	w/US, no edge, no ZOI	24 x 5 x .9 x 1.5 x 91	14.742

Total HE = 184,245 HUD

Net decrease = 22,007 HUD

(-10.67% change from HV)

Table 4: Sample mathematic calculations for HE from Figure 13.

Mortality Routine

The mortality routine is the final element that completes the CEM. The objective of the mortality routine is to quantify the risk of grizzly bear deaths directly attributable to human activities. As mentioned before there is currently no accepted mathematical or computer model for assessing mortality risk for GYE grizzly bears. In fact, there is no working mortality routine associated with any of the grizzly bear CEMs currently in use for threatened grizzly bear populations. This omission is largely due to dissatisfaction among grizzly bear experts with the mortality coefficients developed for the CEM.

Mortality routines were incorporated into most of the earliest versions of the CEM software; up to and including the "unified" version of the ICE6 software. The method of the routines operation remained basically the same through all versions, although the concepts behind the mechanics of this routine changed somewhat over time. Assumptions made in the development of the mortality routine include the following: (USDA 1990)

1. The potential for bear mortality associated with human activities is cumulative and can be expressed as an index to mortality risk.

2. The risk of bear mortality associated with multiple human activities accumulates in an additive manner.

3. The risk of bear mortality associated with activity classifications remains constant.

4. The risk of bear mortality increases with increased human activity or association.

5. The availability of food attractants associated with human activities increases the risk of bear mortality.

6.   The presence of firearms associated with human activities increases the risk of bear mortality.

7.   Risk of bear mortality increases during all legal hunting seasons.

8.   Mortality risk associated with habituated bears is reflected in mortality coefficients.

The original mortality routine developed for the GYE CEM was basically an accounting mechanism for tracking the abundance of human activities associated with factors known to be correlated to grizzly bear deaths. Those factors incorporated into the mortality routine include: 1) habitat quality, 2) nature of the activity (point, linear and dispersed), 3) intensity of use (high, low) 4) availability of attractants, and 5) presence of firearms (USDA 1985).

Habitat quality was included in the routine as a measure of the probability that a bear would be present in the vicinity of an activity. The assumption was that the higher the habitat quality, the more likely a bear (or bears) would be present. Prior to completion of habitat component mapping, habitat quality was considered to be a function of the Management Situation stratification as defined by the Interagency Grizzly Bear Guidelines (USDA/USDI 1979); i.e. all lands designated as Management Situation 1 (MS1) were considered to be high quality habitat and all lands designated as Management Situation 2 (MS2) were considered to be low quality habitat. Lands designated as Management Situation 3 (MS3) and private lands received the habitat quality designation of the adjacent lands (USDA 1985). Once habitat mapping was mostly complete for the ecosystem, habitat quality as considered in the mortality routine became a function of habitat value (HV) as calculated by the habitat routine (USDA 1990).

With the consolidation of the CEMs under the "unified" version, the point was raised that in ecosystems at or near carrying capacity for grizzly bears, habitat quality became less of a factor in determining the likelihood of whether bears may be in a particular area. Displacement by dominant bears was considered to be more of a factor in evaluating mortality risk for ecosystems at or near carrying capacity, as more vulnerable bears, particularly females and young would be forced into poorer quality habitats. To address this issue the "unified" CEM conceptual document stated that ecosystems where habitat quality is an important factor would include specific habitat values in the mortality risk equation whereas ecosystems in which habitat value no longer significantly contributes to mortality risk would use a factor of 1 for the habitat multiplier in the mortality risk calculation (USDA 1990).

Nature of the activity; i.e. whether point, linear or dispersed was incorporated into the mortality routine because a review of mortality data indicated that activities leading to grizzly bear mortalities could be stratified into these categories (USDA 1985). This classification scheme was consistent with the way activities were categorized for the disturbance routine, and also provided a measure of the degree of predictability of human activities. Human activities at point sources are fairly predictable, linear activities slightly less predictable, and dispersed activities are largely unpredictable. Predictability of human activities may differentially influence behavior patterns of wary and habituated bears, and thus affect mortality risk for the population.

Intensity of use; i.e. whether high, low, 24-hour or daytime only, could also alter the use patterns of bears. With increasing intensity of human use the more wary bears

would likely be displaced away from an area and thus possibly avoid encounters with humans. On the other hand, increasing intensity of human use generally equates to more people over a longer time span, and potentially over a larger area. The latter situation ultimately increases the probability of bear/human encounters, particularly in ecosystems where grizzly populations are at or near carrying capacity and bears have fewer options for avoiding people.

Availability of attractants, particularly at point sources of human activity, stood out as a significant factor in grizzly bear mortality data for the GYE (USDA 1985). Availability of food attractants, especially in poor food years can override a bear's natural tendency to avoid humans, and thus could potentially result in grizzly bear mortality.

Presence of firearms plays an obvious role in the determination of mortality risk. In derivation of coefficients, mortality data figures were doubled for known grizzly bear deaths associated with firearms (USDA 1985). This adjustment was based on Knight and Eberhardt's (1985) conclusion that roughly half of firearm-related grizzly mortalities are actually reported.

Mortality coefficients were developed using grizzly bear mortality data obtained from Montana Department of Fish, Wildlife and Parks for the period of 1973 - 1983. Grizzly bear deaths were categorized according to the above factors with adjustments made for firearm-related mortalities. Mortality coefficients were then calculated for each activity category by dividing adjusted losses for each group by the total number of adjusted losses for the ecosystem during the time period reviewed. Original mortality coefficients are listed in the "Blue Book" (USDA 1985).

The mortality routine calculated a mortality risk index (MRI) as the third major model output. MRI was determined for each cell on a daily basis by adding the mortality coefficients for all activities impacting the cell on a particular day. This daily mortality factor was then adjusted for habitat quality as described above. Seasonal MRI was then calculated by summing the adjusted daily mortality factor over all cells over all days in the season as follows:

$$MRI_{AS} = \sum_{c=1}^{n_c} \sum_{d=1}^{n_{sd}} (HV * \sum_{a=1}^{n_a} MC_a)$$

where MC_a indicates activities influencing the cell.

Problems with the mortality routine became evident with the coding of activity attribute files. A special code was added to these files to indicate the availability of attractants and the presence of firearms. Both of these conditions were difficult to code for the following reasons. Availability of attractants was defined in the "Blue Book" as follows: If food storage requirements are in effect, but not enforced, the attractants at the site are considered available. If food storage requirements are enforced attractants are considered unavailable (USDA 1985).

As the Food Storage Order for the GYE covers the entire grizzly bear recovery zone, and has the power of law (36 CFR 261.50 (a) and (b)), it had to be assumed that the order was being enforced throughout the recovery zone. If an activity is known to provide an available food attractant to grizzlies enforcement measures are implemented immediately. Therefore by default, all activities were coded as though attractants were unavailable, even though in reality this was not necessarily always the case.

The second factor, indicating the presence of firearms proved to be equally problematic. Firearms are prohibited inside the National Parks, therefore all activities within Yellowstone and Grand Teton National Parks were assumed not to have firearms present. Conversely, firearms are not restricted on National Forests so all activities on National Forest lands were assumed to have firearms present. Experience tells us that neither assumption is unconditionally true. Due to these problems two of the main factors related to human-caused grizzly bear mortalities were basically useless in the mortality routine of the CEM.

For the above reasons, a totally distinct mortality model was used in conjunction with the CEM assessment conducted for the Fishing Bridge evaluation in Yellowstone National Park. Details of the mortality model used for this project are described in the Fishing Bridge EIS (USDI 1988). Although considered acceptable for the Fishing Bridge project, the alternative mortality routine was not adopted for the entire GYE recovery zone due to assumptions that applied only to National Park lands.

In 1989 the modeling team made an attempt to rectify the problems associated with coding activities for availability of attractants and presence of firearms. Instead of codes specific to these factors, Mattson had developed a new set of mortality codes that would further classify activities as categorized for the disturbance routine into the following mortality classes: 1)sheep grazing, 2) cattle grazing, 3) towns, 4) highways, 5) secondary roads, 6) cabins, residences, campgrounds, trailheads, logging camps, 7) outfitter camps, 8) non-commercial hunting camps, 9) dispersed hunting activity, 10) legal black bear hunting and 11) other.

These new categories were based on a review of more current mortality data and seemed to have great potential for improving the performance of the mortality routine (Mattson pers. comm.) However, the change in coding was never implemented as activity databases were not complete enough to assess the correlation of these categories to probabilities of bear deaths. Time and budget restrictions also prohibited the analysis necessary to make such correlations.

Mortality Coefficients

Further problems with the mortality routine were linked to the mortality coefficients. Mattson, who was one of the primary authors of the mortality coefficients, was one of the first to point out the deficiencies. One notable problem with the coefficients was that the derivation process did not provide a predictive relationship between numbers and densities of human activities and actual loss of bears. In 1987 a recommendation was made to the Yellowstone Grizzly Bear Subcommittee that a biometrician be consulted to assess various approaches to calibrate mortality risk to actual bear deaths (Puchlerz and Weaver 1987). Documentation of any follow up to this recommendation was not found in the literature search for this paper.

Mortality coefficients were basically considered to be dimensionless indices as values assigned to activity classes were not related to current or historic levels of activities. For example, low use linear activity features were assigned a coefficient of .01; however there was no consideration of the quantity (e.g. miles/square mile) of this type of feature present in the ecosystem. Therefore conclusions could not be drawn regarding the

potential to lose x number of bears per y miles of linear activity in the ecosystem. To draw this type of conclusion required an extensive database of existing and historical activity levels. The human activity database developed for the CEM could provide at least data for the existing condition, but this database was not yet complete when the modeling team was struggling with the mortality routine.

In May 1991 Rodd Richardson called a meeting of modelers and grizzly bear experts to discuss the status of the CEM mortality routine. Meeting participants included Rodd Richardson - USFS Grizzly Bear Habitat Coordinator, Rich Harris - Montana Cooperative Wildlife Research Unit, Dick Knight - Interagency Grizzly Bear Study Team Leader, Dave Mattson - Interagency Grizzly Bear Study Team Researcher, and Collin Bevins - Systems for Environmental Management Contractor and programmer of CEM software. Conclusions drawn at this meeting were summarized by Richardson in a letter to modeling team leaders as follows:

1. Everyone at the meeting agreed that we need to keep looking for a better way to model grizzly bear mortality.

2. Completing CEM databases for the recovery zone is a necessary first step.

3. A pilot test to examine quantitative methods of modeling mortality can be attempted in areas where data and funds are available. The database for such an analysis would involve a large part of both the vegetation and activity layers for a recovery zone. It appears that the GYE database may be the first available to begin this process.

4. It may be easier and more effective to use raw mortality data for required analysis

during this development phase for the mortality routine. Most field units are using this process now (Richardson 1991).

Based on these conclusions Richardson recommended suspension of the use of the CEM mortality routine in all ecosystems. The Yellowstone modeling team dropped the existing mortality routine in 1992 (YMT notes 2/92). The current version of CEM software (ICE9) does not include any type of mortality routine. The fact that the mortality routine has *temporarily* been dropped from the CEM is by no means an indication that this facet of cumulative effects assessment is considered to be any less important than the habitat evaluations accomplished by the habitat and disturbance routines. Mortality risk assessment is a very high priority for the Yellowstone modeling team and the Grizzly Bear Subcommittee.

Model Output

The ICE9 software produces both numeric and graphic output for CEM analyses. Numeric outputs are presented in ASCII text files which contain the following fields: 1) project name, 2) snapshot name, 3) partition name, 4) number of cells within the partition, 5) acres within the partition, 6) season beginning date, 7) season ending date, 8) number of days in the season,   9) total seasonal habitat value scores for the partition, and 10) total seasonal habitat effectiveness scores for the partition (Bevins 1997).

Project name refers to the overall project label. In the GYE the project is typically run at the BMU level and thus the BMU name is the project name. However, the model is capable of considering any segment of the CEM database as a distinct project. GYE

protocol is to run all projects at a minimum of the BMU scale. The model could theoretically be run as one project for the entire ecosystem, although this task has yet to be accomplished.

Snapshot name refers generally to either a phase of model evaluation, or to chronological assessments, or different land management scenarios. Different "snapshots" can be used to evaluate different phases of the model by providing separate output for each data layer. In this way, we can evaluate the relative contribution to model output (HV and HE) of each data layer; e.g. vegetation, supplemental, point, linear and dispersed activities can be loaded into the model and evaluated separately. The snapshot label can also be used to evaluate chronological assessments; i.e. changes over time. Another use for the snapshot label is simulation and evaluation of various land use proposals; e.g. with and without the New World Mine.

Partition name refers to the various boundaries included for assessment in a model run. Again, GYE protocol dictates that the BMU is the minimum scale for CEM analyses, but the software is designed so that the modeler can include any (reasonable) number of internal boundaries for the model to report HV and HE scores. Examples of internal boundaries or "partitions" as the software labels them include subunits, administrative units and female grizzly bear home ranges. These examples are just a few, and there are many possible boundaries or partitions that CEM users may find desirable to evaluate.

Cells, acres, seasonal dates and number of days are self-explanatory. Total Habitat Value (HV) and Total Habitat Effectiveness (HE) are calculated as described in this document. These scores are expressed in Habitat Unit Days (HUD) which is the term

used to represent HV and HE summed over all cells (multiplied by a factor of 5 to account

for acres in each cell) and over all days in the season. With BMUs averaging about

300,000 acres in size, a minimum of 91 days in the shortest season (fall: Sept. 1 - Nov. 30)

and a maximum of 275 days in the longest 'season' (annual: Mar. 1 - Nov. 30) it is quickly

apparent that habitat scores in terms of HUD are very large numbers, typically in the tens

of millions at the BMU scale in the GYE.

To make HUD values more manageable and also to facilitate comparison of habitat

scores between analyses, HUD values are normalized by converting to per acre per day

values by dividing HUD scores by total acres for each partition and by number of days for

each season. The ASCII file format of the CEM output readily facilitates this and other

types of analysis and display. CEM output files can easily be read into spreadsheets and/or

text editors to produce further calculations and summary reports (Bevins 1997). An

example of ICE9 numeric output is presented in Appendix C.

ICE9 software includes a program that reads the binary map files produced by the

CEM analysis and generates ASCII map files for use with GIS technology. This program,

called "icebridge" essentially "bridges" the gap between binary model output and graphic

displays of model results. Icebridge can be used to generate the following map themes:

1) Habitat value (HV) by season, 2) Habitat effectiveness (HE) by season, 3) Habitat loss

(HV - HE) by season, 4) cumulative displacement (HE/HV) by season, 5) security cover

type and 6) edge densities (Bevins 1997). Examples of some of the maps produced by

ICE9 are also presented in Appendix C.

CHAPTER 4

FUTURE DEVELOPMENT

The previous chapters provide a central repository for documentation of the current and historical development of the GYE CEM. At this point, I will change focus to the future of cumulative effects modeling for grizzly bears in the GYE. In order to proceed with meaningful dialog and recommendations for future development of the CEM, an evaluation of the utility and limitations of the model is necessary. This chapter represents my assessment of the GYE CEM, and may not reflect the position of the Yellowstone Modeling Team or any of the associated GYE agencies.

The future of the CEM will focus on testing and validation of model elements, as well as ecosystem-wide applications. Criticism of the CEM has often referred to the lack of testing and validation of the model prior to its use, and application of the model for site specific assessments. With a complete database for the ecosystem and a more efficient software package, we can proceed with these phases of the modeling effort that have previously been considered limitations to the CEM's effectiveness as a management tool.

The urgent need for a tool to facilitate cumulative effects assessment has led to implementation of the CEM, primarily on a large project basis, prior to any organized testing, validation or peer review of the model. Although such uses of the model have

proceeded with extreme caution, the fact that it was being used in decision making without any thorough examination of the model components was viewed by some as a management impropriety (Sidle 1987, Mattson and Knight 1991, Knight 1996).

The prolonged time required to complete the CEM database has been a deterrent to proceeding with testing and validation efforts. Limited funding and access to modeling expertise further constrained these endeavors. A first step in model validation is to complete CEM runs for the entire ecosystem using one software package so that model outputs can be evaluated for all BMUs and comparisons made to actual bear use data. A GYE-wide CEM assessment using ICE9 1.1 software is schedule for April 1998. All runs will be made by the GYE CEM database coordinator to ensure consistency.

Once CEM outputs are available for all BMUs, testing needs can be prioritized and submitted to the Yellowstone Ecosystem Subcommittee for approval. Funding for model testing and validation will be appropriated by the Subcommittee. These efforts will compete for limited funding with many high-priority grizzly bear conservation issues. A short-term plan for model testing, validation and revision is presented later in this chapter.

Future development needs for the GYE CEM can logically be divided into four main categories: database, conceptual design, model parameters (coefficients), and software. Each facet must be reviewed to determine the overall effectiveness and applicability of the CEM to GYE grizzly bear management issues. These categories will be addressed with regard to utility, limitations, past modifications and future needs for testing, revision and further development.

Database

The GYE CEM operates on a large, complex database that provides a high resolution representation of the ecosystem. One common criticism of the database is that data was collected at a much finer scale than is necessary for assessing large-scale impacts upon the habitat of such a wide ranging species. However, grizzlies are an opportunistic species with diverse food habits, so the habitat type approach contributes information regarding a multitude of potential bear foods.

One of the purposes of developing this model was to evaluate alternative land uses in an ecosystem where competition for resources is intense and allocation of resources is expected to be based on analysis of tradeoffs (Mattson 1993a). With higher resolution data we can theoretically increase the precision of our analyses so that tradeoffs can be considered in fine detail in order to treat the various competing interests fairly.

The CEM database provides high resolution representation of habitat features (mapped to a minimum of 5-acre polygons) and human activity features (mapped individually). Although such high resolution data may allow for greater precision in our analyses, it does not necessarily equate to a high level of accuracy. One problem with managing the use of CEM data is that the high resolution gives the impression that the database provides the specificity and accuracy required for site-specific evaluations. This is not necessarily the case, as only a portion of the mapped data were field verified for accuracy and the rest of the information was extrapolated.

The ecological classification system of the vegetation data and the general classification system of the human activities data were intentionally selected to increase the utility of the database for purposes other than grizzly bear habitat evaluation. CEM data have been used for multiple purposes such as timber and range inventories, fire planning, roadless area inventories, transportation planning, recreation and wilderness area planning. The database has been sought after by state and local agencies, universities and the general public for various research and planning projects. Due to the potential for a wide range of natural resource and land use planning applications, I feel that the GYE CEM database is indeed a valuable asset.

Critical review of the database is still necessary to determine the accuracy of the mapping and coding, as well as whether the most critical factors of grizzly bear survival are represented in the data used by the CEM. Limited review has occurred through consolidation of the corporate database for the entire GYE. Bringing data together across administrative boundaries emphasized mapping and coding discrepancies so that they could be identified and corrected with a team effort to improve consistency.

Vegetation

Field sampling rates for vegetation data varied across the ecosystem. The mapping handbook (Mattson and Despain 1985) specified a sampling scheme of every other photo from every other flight line for field verification. This scheme requires field visitation of approximately 1 out of 4 photos, or roughly a 25% sample. At first glance it may appear to be a small proportion, but considering that the GYE covers approximately 6 million

acres, a 25% sample equates to roughly 1.5 million acres of field verified information on vegetation types.

Yellowstone Park personnel deviated from the prescribed sampling scheme as their mapping was completed prior to the mapping handbook. Shoshone National Forest personnel also deviated from the standard. They felt there was sufficient pre-existing field data to adequately extrapolate vegetative habitat types without conducting the procedure outlined for the CEM. Of those administrative units that did follow the mapping handbook sampling scheme, most used some degree of "like-typing" (as described in Chapter 2 for the Gallatin National Forest) which resulted in less than 100% of the polygons in a field sample photo being visited on the ground.

To further complicate the issue, most units used existing field data where available; e.g. timber stand exam data and range inventories, but likely did not keep accurate records documenting the use of this information. It would be difficult to re-trace steps to determine the actual level of field sampling incorporated into the vegetative habitat database due to personnel turnover and lack of records. Based upon my personal history with the GYE mapping effort (1984 to present) I feel that an estimate of 25% field sampling is a fair *approximation* for the CEM vegetation database.

Field classification error also likely varied across the ecosystem. Vegetation classification in Yellowstone National Park was conducted by botanists (Despain pers. comm.) Outside Yellowstone Park, the majority of classification was done by individuals trained in forestry, range, wildlife biology and soils. Extrapolation of field data was conducted by individuals with aerial photo interpretation and habitat typing skills.

Multiple types of error can detract from the accuracy of the vegetation data layer. Potential sources of error include polygon delineation on aerial photos, delineation transfer between aerial photos and base maps, field classification, coding in the field, coding transfer between field data and base maps, extrapolation and digitizing.

Accuracy of the vegetation data has been verified on a small scale by individual units "spot checking" their own mapping. On a larger scale, the vegetation database was corrected for errors detected through consolidation of all administrative units for purposes of the 1988 fire update. For this process, Roy Renkin of Yellowstone National Park and myself were assigned the task of identifying obvious coding errors associated with the corporate (ecosystem-wide) vegetation database.

I examined a list of all vegetative codes, including mosaic combinations, encountered in the GYE data consolidation effort and made notation of erroneous codes. In this effort, codes were identified as "errors" for the following reasons: 1) too many or too few digits (valid codes were in multiples of 5-digits), 2) invalid habitat type codes according to Pfister et al. (1977) and Steele et al. (1983), 3) invalid cover types and/or nonforest types according to Mattson and Despain (1985) and 4) habitat/cover type combinations that did not make ecological sense; e.g. low elevation habitat type with high elevation cover type.

Renkin then took the list of erroneous codes and ran a frequency distribution for the vegetation data available across the ecosystem. Based on the frequency distribution, the modeling team decided that the level of error warranted correction. A complete list of invalid codes was forwarded to the GYE CEM database coordinator, who produced maps

for each administrative unit with vegetation coding errors identified. Individual units were responsible for correcting the errors and sending the rectified data back to the database coordinator for modification of the corporate database.

Further validation of a small portion of vegetation data was provided in conjunction with use of the CEM to assess impacts to grizzly bear habitat from activities associated with the proposed New World Mine in the northeast corner of the GYE. The CEM was to be used in this analysis as an accounting tool for mitigation purposes; i.e. the mining company would be held accountable for replacing grizzly bear habitat "lost" due to mining activity as measured by the model. In order to ensure accurate accounting, the IGBST was contracted to conduct a 100% ground truthing of vegetative habitat within an area of approximately 48,000 acres surrounding the proposed mining activity.

The resulting vegetation map was compared to the original mapping produced by Gallatin National Forest personnel, by ocular method as well as by running the two data sets through the habitat routine of the CEM. The results of both comparisons indicated that the differences between the two mapping procedures were negligible. Model output for both data sets varied less than 5%. Caution should be used in attempting to extrapolate these results to express confidence in the accuracy of the vegetation mapping for the entire ecosystem as many different individuals conducted mapping efforts across the GYE.

Of additional concern with the corporate vegetative database are the differences in mapping scale, resolution and technique between those employed by Yellowstone National Park and the rest of the administrative units. Recall that Yellowstone National Park vegetation mapping was completed prior to the establishment of mapping procedures for

the GYE CEM. Although early efforts in Yellowstone Park pioneered vegetation
mapping for the rest of the ecosystem, the procedures used in this initial effort have
resulted in notable discrepancies within the corporate vegetation database.

Yellowstone Park vegetation polygons were delineated on aerial photos at a scale
of 1:15840 and transferred by simple ocular method to topographic base maps at a scale of
1:62500. Orthophoto base maps and larger scale topographic maps were not available at
the time. This methodology had potential for transfer errors due to difference in scale, the
transfer method and the difference in media (aerial photos vs. topographic maps). In
contrast, surrounding administrative units delineated polygons on aerial photos at a scale
of 1:24000 and transferred delineations by simple ocular method to orthophoto base maps
of the same scale. This process reduced the potential for transfer error.

An evaluation for transfer errors could be conducted by "clipping" digital
vegetation data by the boundaries of several 7.5-minute quads representing different
landscape patterns across the ecosystem. The "clipped" data could then be plotted out at a
scale of 1:24000 and overlaid with the corresponding orthophoto base maps to determine
whether the polygons defined by the digital data match vegetative patterns represented on
the orthophoto base maps.

Different mapping techniques produced Yellowstone Park vegetation data at a
scale of 1:62500 with a minimum mapping resolution of 10 acres, while the rest of the
ecosystem was mapped at a scale of 1:24000 with a 5-acre minimum mapping resolution.
Yellowstone personnel also mapped habitat types separately from cover types and later
combined the two layers, whereas other units mapped habitat/cover type combinations as

one layer. The mapping discrepancies are clearly visible on ecosystem-wide vegetative maps as the border of Yellowstone Park is easily distinguished by differences in vegetation polygons. These divergences warrant further analysis to determine whether the differences in mapping procedures produce significant variation in CEM outputs.

Modern technology could be applied to evaluate the accuracy of the entire vegetation database. Habitat types are based on physical attributes of the landscape such as elevation, aspect, soil type and moisture regime. Perhaps a model could be designed using digital elevation maps, soil maps and satellite imagery of vegetation (classified in terms of wetness, brightness and greenness to reflect moisture content) to predict where various habitat types, or groups of habitat types, are likely to occur in the ecosystem.

Predictive capabilities of this type of model could be assessed using existing GYE field data collected by individuals trained in habitat typing techniques. This effort would require a year or more to develop the model, plus several months to compile existing field data and compare with model output. However, it would be more time and cost effective than the alternative of additional extensive field verification of existing data.

Results from such a model could be used to assess the accuracy of the existing vegetation database and correct codes where deficiencies are indicated. Results from the habitat type prediction model would not be sufficient to replace the existing CEM vegetation maps as they would not accurately represent forested cover types as currently described for the GYE CEM. However, if such a model were determined to produce more accurate habitat type maps than the existing vegetation data, a combination of the two could be used to create an improved vegetation map for the GYE.

Supplemental

The supplemental habitat data layer has potential utility beyond the evaluation of grizzly bear habitat. This data layer can provide biologists and managers with information regarding important ungulate seasonal ranges so that these areas can be protected from human disturbance during critical time periods such as calving season. The information could also prove useful in the research and management of other predators such as black bears (*Ursus americanus*), mountain lions (*Felis concolor*), wolves (*Canis lupus*), coyotes (*Canis latrans*) and wolverine (*Gulo gulo*). In addition, this data layer can provide information to help minimize bear/human conflicts during periods when grizzly bears are known to utilize these high-energy food sources.

The existing supplemental habitat data layer has known discrepancies in the mapping conducted by different administrative units. This condition will be remedied and mapping will be much more consistent across the ecosystem with adoption and slight modification of Mattson's more recently developed supplemental habitat map for the ecosystem. The modeling team agreed that this new map will provide a more accurate representation of supplemental food sources. State wildlife agencies should be consulted for assessment and potential refinement of the new map when it becomes available.

Human Activities

Beyond use with the CEM, the human activities data layer has potential for a multitude of natural resource and land use planning applications. Examples include, but are not limited to, transportation planning, recreation impact assessments (e.g. effects of

winter recreation on bison in the GYE), identification and conservation of roadless areas, trends in wilderness use over time and monitoring of human development within the ecosystem. This data also has potential for use in habitat effectiveness evaluation for wildlife species other than grizzly bear.

Accuracy of the human activity database is more easily determined and maintained than other data layers due to our inherent tendency to track this type of information. Technology such as Global Positioning Systems (GPS) can be used to further enhance the accuracy of spatial location by pin-pointing the geographic coordinates of features to within several meters. GPS technology has already been used to locate some point and linear features in the GYE. Dispersed activities are by their nature more difficult to define on a map, and thus not likely candidates for use of GPS to refine locations.

Considerable verification of the accuracy of linear features has occurred with the consolidation of this data layer across the ecosystem. Edge matching of linear features across administrative boundaries has required a team effort to provide greater consistency in the mapping and coding of linear features such as roads and trails. Digital data is also now available in the form of USGS cartographic feature files (CFF) for most of the ecosystem. Incorporation of CFF data into the CEM linear features will further improve the accuracy and consistency of this data layer. The Gallatin National Forest has already integrated CFF data into the linear layer. Other units are expected to follow.

Point data also need to be reviewed for consistency of mapping between (and even within) administrative units. Assessment of the accuracy and consistency with which point sources have been mapped has been limited as these features generally do not cross

administrative boundaries so there has been no need to edge match this layer. The primary

discrepancies in the mapping of point activities were described in Chapter 2. Ongoing

efforts to resolve those differences are discussed below.

Recently, the modeling team has decided to map major developments as a single

point with a large (2.5 mile) zone of influence (Barber 1997). The dilemma is in the

determination of what constitutes a "major" development. This classification is obvious

for towns and communities that are populated on a year-round basis. Difficulty comes in

attempting to classify resort complexes, summer home areas and large developed

campgrounds that may only be occupied for part of the year, and/or are spread out

geographically so that even a large zone of influence will not represent the spatial impact.

Seasonal and annual population levels will play an important role in defining point

clusters. The modeling team is scheduled to establish new mapping criteria for point

clusters and major developments. Once standard procedures are finalized, each

administrative unit will be responsible for updating their mapping and providing the

modified data to the database coordinator for consolidation into the corporate database.

Another discrepancy in the coding of point sources involves the distinction

between motorized and non-motorized point activities. Most units mapped point activities

associated with roads (i.e. the point can be driven to), as motorized point sources.

Updated activity definitions for CEM indicate that only those point sources which produce

loud motorized equipment noises are coded as "motorized points" (USDA 1990).

Modeling team discussions indicate that changes to point activity data have occurred on a

very limited basis.

Dispersed activities cross administrative boundaries and thus require edge matching; however, this task has not been fully accomplished for the ecosystem. Edge matching that has occurred indicates considerable differences of interpretation regarding the extent and degree of dispersed human activity within the GYE. This condition is not unexpected, as the very nature of dispersed use makes it difficult to define this type of activity in terms of spatial extent and intensity levels.

There has been some discussion as to whether dispersed activities contribute enough to habitat evaluation to warrant the continued inclusion of these features in the model. However, it is recognized that certain dispersed activities, particularly big game hunting, are important in mortality risk evaluations. It is possible that the zones of influence associated with linear and point activities could accurately account for grizzly bear mortalities associated with dispersed hunting. This theory should be evaluated as part of the process to develop a new mortality routine for the model.

Data Maintenance and Update

An important step for database maintenance is development of a system and schedule for updating data over time. Now that we have complete data coverage for the ecosystem we can focus more attention on developing and implementing a data update system. Our experience with the 1988 fires has shown that satellite imagery can be used for modifying vegetation data to reflect conversion of forested cover types to early succession due to environmental perturbations. However, we do not have a mechanism in place to systematically modify the database for forward succession and much of our

vegetation mapping is already more than a decade old. Here again satellite imagery may prove useful. A comparison could be made between CEM vegetation maps and satellite imagery of the same vintage. If there is a good correlation between CEM cover type codes and satellite spectral classifications, this relationship could be used to update CEM cover types with current satellite imagery.

We also have yet to establish procedures for updates of supplemental habitat features or human activities. State wildlife agencies and National Parks generally keep current information regarding ungulate seasonal ranges and fish spawning streams. These sources should be consulted periodically to update the supplemental habitat data. Human activities data should be revised annually by local agency personnel.

Conceptual Design

The conceptual design of the CEM should again be reviewed to determine whether we are in fact addressing the proper questions with our model. The original conceptual model was peer reviewed in 1984 and 1985 by a wide variety of grizzly bear researchers, managers, modelers and academicians. Most reviews were highly favorable of the original conceptual design. However, many years have passed during which new data have been gathered and new theories and technologies have been advanced with respect to grizzly bear biology, ecology and management.

Various efforts have developed alternative modeling techniques for evaluating human impacts upon grizzly bears and other species. In the Northern Continental Divide Ecosystem (NCDE) Mace et al. (1996) have described methods used to evaluate the

impact of varying degrees of road densities upon habitat selection by female grizzly bears. In this study, broad general landscape types were delineated based on elevation, cover type and land ownership. A road density layer was added to the land type map to represent human access into grizzly bear habitat. Telemetry data from radio-collared female grizzly bears was added as a final layer to evaluate the habitat selection patterns of this cohort relative to the presence of human access routes. This methodology was referred to as "resource selection function" (RSF) as described by Manly et al. (1993).

Results from the NCDE study showed a clear preference by female grizzly bears for habitat with minimal impact from roads and a corresponding negative association between habitat selection and increasing road densities (Mace et al. 1996). One of the primary differences between the NCDE model and the GYE CEM is that habitat selection in the NCDE model was based on the probability of bears using an area; it was not explicit as to *why* bears were in a particular area; e.g. feeding, resting, traveling through, etc. In contrast, the GYE CEM vegetation coefficients are based on known feeding activities.

Whether one method provides greater insight to the overall survivability of the different bear populations studied is currently in debate. However, it seems likely that the vegetation coefficient approach used in the GYE may provide greater utility in predicting potential habitat capability in terms of food production for an expanding grizzly bear population as found in the GYE (Picton pers. comm.)

The model used in the NCDE study was based on a much simpler database produced with considerable economic and time savings over the GYE CEM database. However, the size of the land base covered is considerably different; i.e. the NCDE study

area was 1,457 km² (approximately 360,000 acres) whereas the GYE at 6 million acres is over 16 times the size of the NCDE study area. Further, there is considerable political pressure in the GYE to use a higher resolution database so that tradeoffs can be assessed with greater precision in attempting to allocate resources between competing interests such as human recreation, resource extraction activities and grizzly bear conservation (Mattson 1993a).

The methods described for the NCDE do have potential application for grizzly bear management issues in the GYE. Indeed, RSF evaluation has been proposed for the GYE (Servheen, Boyce, Ouren, pers. comm.) In modeling team discussions, it has been recognized that RSF modeling could be used with the existing GYE CEM vegetation database to further evaluate the accuracy and utility of the existing data.

Another modeling venture involves concurrent efforts in the GYE to evaluate the impacts of human access into grizzly bear habitat. As mentioned earlier, the linear activity layer (roads and trails) from the CEM database will be used in an "access analysis" for the GYE grizzly bear recovery zone (USDA/USDI 1994). In this model, GIS technology will be used to calculate road densities and identify potential "habitat core areas" for the GYE, similar to the methodology described by Mace et al. (1996). Results from the GYE access model will be used to establish "access standards" for the GYE (USDA/USDI 1994) and will also likely be used in the development of habitat based recovery criteria for the GYE grizzly bear population.

The major limitation of the access model is that results from the analysis, by themselves, do not reflect habitat quality other than by the presence or absence of human

access densities; i.e. food and cover factors are not explicitly identified by access model output. In the GYE, the CEM habitat data (vegetation and supplemental) will be used to further evaluate the quality of potential "habitat core areas" identified through the access modeling effort.

A third grizzly bear habitat evaluation modeling exercise currently under consideration in the GYE is a basic accounting system for monitoring human activities. This system, referred to as the "Subunit Table", is merely an accounting by Bear Management Subunit, of various parameters considered to influence grizzly bear management. The Subunit Table concept was developed in an effort by Forest Service personnel (K. Barber, B. Noblitt, M. Cherry and T. Puchlerz) to gain more information about specific types of human activities relative to grizzly bear recovery goals.

The Subunit Table provides more specific information than the general activity categories used in the CEM activities database. Examples of information provided include, but are not limited to: breakdown of subunits by landownership, proportion of subunits within the suitable timber base on National Forest lands, proportion of subunits within grazing allotments, number of summer homes and year-round residences, number of developed campsites and number of food storage facilities. Additional information is recorded with respect to habitat parameters such as HV and HE calculations from the CEM, percent core and road densities from the access model, grizzly bear population parameters such as number of unduplicated sightings of females with young, number of known human caused mortalities, and social factors such as the number of bear/human conflicts and associated management actions.

All of the models described above have potential application to multiple natural resource issues in the GYE and elsewhere. Certainly, these models all lend valuable insight to the difficult task of managing human land uses toward the goal of grizzly bear recovery. As the elements of the CEM are being tested and validated, I believe that a combination of the modeling techniques described above will strengthen our ability to make sound management decisions.

Modeling theory implies that the best models include only the minimum number of variables necessary to capture the behavior of interest (Hansen pers. comm.) Given the large number of variables in the GYE CEM, it appears that the model may be too complex. However, we are dealing with a wide ranging, behaviorally complex and very opportunistic species. Further, we have a relative wealth of knowledge regarding grizzly bears in the GYE. It would be a disservice to exclude any of this information from our modeling efforts unless proven to contribute nothing, or lead to incorrect management decisions. In order to determine which elements are critical to the CEM, we will need to conduct further sensitivity testing to identify those variables with the greatest contributions to model output.

A second formal peer review of the conceptual design of the CEM would benefit the GYE modeling effort. This review should involve grizzly bear researchers and managers from other ecosystems including Alaska and Canada, plus a wider range of modelers, statisticians and programmers. Information sharing could result in vast improvements over the current design of the CEM, including new and better ways to combine features from different models to obtain a better product.

Specific questions for a peer review to address regarding various aspects of the conceptual model design include the following:

Routines

Are the current *conceptual* routines (habitat, disturbance and mortality) addressing the most critical factors of grizzly bear recovery in the GYE? If not, what other facets of grizzly bear biology, ecology and management need to be incorporated into the CEM? If so, are these routines (with the obvious exception of the mortality routine) designed properly to adequately address current grizzly bear management issues? How should we go about rebuilding the mortality routine?

Equations

Are the mathematical equations for determining habitat value (HV) and habitat effectiveness (HE) accurate representations of grizzly bear habitat use patterns in the GYE? What factors should be included in the development of new equations to assess mortality risk due to human activities? Are the factors in the existing equations treated properly based on accepted modeling techniques?

It must be recognized that the degree of error associated with individual model coefficients is multiplied when the coefficients are treated in a multiplicative manner (Picton pers. comm.) This issue of error propagation is potentially problematic in the calculation of HV with the multiplication of vegetation, edge and supplemental coefficients, as well as in the calculation of HE with the multiplication of disturbance coefficients for overlapping activities.

Output

Do model outputs for habitat value (HV) and habitat effectiveness (HE) give managers the information they need to make informed decisions regarding land use activities in grizzly bear habitat? How should model outputs be interpreted across the GYE? These questions pose problems for managers trying to make difficult decisions and for biologists attempting to provide input to the decision-making process.

Experience from past attempts at using the CEM has provided guidance for output interpretations as well as demonstrating the strengths and limitations of the model. The first analysis using the GYE CEM was in a biological assessment of the proposed Ski Yellowstone resort on the Gallatin National Forest (Grotzinger 1987). Model results were interpreted in this analysis through examination of overall changes in habitat effectiveness from habitat value (considering existing and proposed activities) as well as incremental changes due to the additional activities proposed. Lack of meaningful thresholds for habitat effectiveness forced the analysis to emphasize incremental change over the *cumulative* effects of all activities, because, as reviewed by Mattson and Knight (1991) "there was no basis for deciding whether (the overall reduction from habitat value to habitat effectiveness) was enough to preclude any further human activities."

Mortality risk assessment in the Ski Yellowstone analysis was likewise focused on incremental impacts, again partially due to the lack of thresholds for mortality risk, but also because the mortality coefficients had no direct correlation to actual probability of grizzly bear deaths associated with human activities. Without this critical tie to actual mortality rates, the model outputs could only be interpreted to indicate that additional

human activities increased the risk of grizzly bear mortalities. The extent of this increase could not be determined accurately.

From this and other pioneering efforts, such as the Fishing Bridge assessment conducted in Yellowstone National Park (USDI 1988) and various timber harvest analyses performed by the Gallatin, Targhee and Bridger-Teton National Forests, valuable lessons were learned regarding the utility and limitations of the CEM. These early attempts at using the model revealed that it could be a beneficial tool for evaluating the placement and scheduling of activities as well as for designing mitigation measures. The model was also deemed to be helpful when used in conjunction with independent assessments based on biologists' intuitive impression of proposed projects. Particularly in cases where biologists had little experience with grizzly bear issues, model correlations with intuitive assessments were reassuring and seemed to increase the credibility of newer biologists in grizzly bear habitat (Eckert pers. comm.)

From past experiences with the GYE CEM, we learned that neither the data nor the coefficients were accurate enough to be used for site-specific project analyses. Attempts to interpret the mortality routine outputs raised discomfort levels to the point where the routine was eventually rejected. Early modeling efforts to assess proposed timber harvest on the Targhee National Forest revealed that the original edge coefficients for "created" edges caused serious inflation of habitat value scores with the removal of overstory; a condition that was not supported by empirical data. We have modified the model based on these lessons; however, interpretation of model output continues to be a weak point of GYE modeling efforts.

The primary difficulty with interpretation of model results is that there is still no tie to grizzly bear demographics for existing CEM outputs. For example, HV and HE are expressed in terms of habitat unit days (HUD). We do not know how many HUDs are required to support a viable population of grizzly bears in the GYE. Indeed, we have not yet determined what constitutes a viable population of grizzly bears in the GYE (Mattson and Knight 1991).

Therefore, it is impossible to say with any degree of confidence whether existing levels of habitat effectiveness are sufficient to provide long-term support of a viable population of grizzly bears in the GYE, or at what point human activities and associated habitat degradation will jeopardize the continued existence of the population. This condition emphasizes the need for a GYE grizzly bear population viability analysis and subsequent establishment of population goals.

Thresholds

The issue of relating CEM outputs to grizzly bear demographics has long been debated in the GYE in terms of establishing thresholds for acceptable levels of human activity; i.e. habitat effectiveness and mortality risk. It has long been recognized that without thresholds, or a meaningful tie to grizzly bear demographics, the CEM outputs are basically dimensionless indices, of limited value with respect to assessing the overall impact of human activities on the GYE grizzly bear population.

We can use model outputs in their existing form to evaluate human activity loads in a relative sense; i.e we can intuitively say that larger HE values are better for grizzly

bears than smaller HE values, and we can compare outputs for BMUs with high levels of human impacts to BMUs with little human impact, but we still cannot answer the all-important question of "what level of HE is necessary to support a viable population of grizzly bears in the GYE?"

The threshold debate goes back to early development of the CEM. The original CEM manual, i.e. the "Blue Book" discussed thresholds as follows: "A final step in the development of a cumulative effects assessment entails establishing and validating threshold levels. These thresholds represent the minimum acceptable levels of habitat effectiveness and/or mortality risks required for species recovery." (USDA 1985:21)

Concerns about thresholds for CEM were expressed from two perspectives. Managers were concerned that establishment of numeric thresholds for the CEM would minimize flexibility for managing land uses. There was concern that model outputs would become the final factor used to determine whether or not certain projects could proceed. Others were concerned that CEM thresholds would be abused and that agencies would tend to "manage down" to threshold levels in order to maximize human activity levels in grizzly bear habitat. Regardless of this debate, thresholds were generally considered necessary to facilitate the interpretation of model results.

In December 1987 a proposal for developing thresholds was introduced. The procedure outlined seven basic steps which are described briefly below:

Step 1:   Establish population objective for recovery in terms of abundance and

distribution of reproductive individuals for a specified probability of

persistence and period of time.

Step 2:   Determine 'habitat unit days' (HUD) needed to support adult females with

young, accounting for overlapping home ranges.

Step 3:   Determine HUD needed to support recovery population of adult females.

Step 4:   Determine habitat effectiveness in HUD for each BMU separately and total

for the entire Recovery Zone.

Step 5:   Determine if the Recovery Zone contains sufficient habitat units to support

a recovered population.

Step 6:   Determine whether each BMU contains sufficient HUD to support at least

one adult female to satisfy the distribution parameter of the Recovery Plan.

Step 7:   Select a level of habitat effectiveness that reflects acceptable risk of

providing sufficient habitat for a recovered population (USDA 1987).

This proposed procedure was distributed to over 50 federal and state researchers

and managers for technical review. A total of 20 responses were received from the states

of Montana and Wyoming, USDI Fish and Wildlife Service and National Park Service,

USDA Forest Service and the Interagency Grizzly Bear Study Team. A synopsis of the

comments received and a slightly revised procedure were forwarded to managers and

biologists of various agencies involved with grizzly bears in the Greater Yellowstone,

Northern Continental Divide, and Selkirk/Cabinet-Yaak ecosystems (Weaver 1988).

The procedure for developing thresholds was never formally adopted by the

Yellowstone Grizzly Bear Subcommittee nor implemented in the GYE. Reasons for this

are probably multi-faceted, but are not well documented. One obstacle that precluded

implementation of this procedure was the fragmentary nature of the CEM database at the

time the threshold procedure was developed. Several BMUs had yet to be completely mapped for habitat and human activities by 1987. In addition, the 1988 fire event in the GYE drastically changed the nature of the landscape in terms of grizzly bear habitat, and altered the nature of human activities to some degree as well. In the proposed procedure outlined above, steps 2, 4, 5 and 6 are all critically dependent upon the CEM database to make the calculations identified.

Parameters (Coefficients)

The parameters that drive the CEM are the model coefficients; e.g. vegetation, edge, supplemental, disturbance and mortality. Concern has been expressed by model developers and users, managers and 'external' critics regarding the validity of the model coefficients. There is universal agreement that all model coefficients need to be revisited. Also, a mechanism is needed for revising or adding new coefficients as grizzly bear populations expand and/or new information becomes available. Following is a synopsis of past and present efforts and future questions relevant to model coefficients.

Vegetation

Various related efforts have been made to expand the list of vegetation coefficients by extrapolating values to fill in the gaps where vegetative habitat/cover type combinations did not have coefficients (see chapter 3 for details). In addition, at least two proposals have been made to review and revise the vegetation coefficients based on additional bear scat and feeding site data coupled with more complete habitat and human activity data for

the GYE. The first proposal came from Mattson in 1987-1988 and the second in 1996 also from the Interagency Grizzly Bear Study Team (Swalley 1996). Neither proposal was carried through.

At the modeling team meeting in June 1997, Mattson was again approached about revising the vegetation coefficients. He expressed interest and suggested an approach similar to the original method of coefficient derivation, using complete habitat data for the entire recovery zone and bear data from 1977 - 1997. The new method is expected to be more straight forward and thus easily understood, and to include spatial and temporal variability in habitat quality.

The revision should eliminate segregation of "with" and "without" ungulates vegetation coefficients, but instead may base the analysis on good and poor food years (particularly whitebark pine) to come up with two sets of vegetation coefficients. The proposed process will evaluate habitat use by different sex and age cohorts in an attempt to calibrate the coefficients to grizzly bear demographics (Mattson pers. comm.)

Seasons

Another variation of the proposal to revise vegetation coefficients involves modification of the existing division of seasons in the CEM. Mattson's recent work indicates four distinct seasons relative to grizzly bear foraging patterns; the CEM currently operates on three foraging seasons. The seasons proposed for the analysis to revise vegetation coefficients are:

o   Spring: March 15 through May 15 - carrion season

o   Early Summer: May 16 through July 15 - calving and spawning season

o   Late Summer: July 16 through August 31 - moth season and early hyperphagia

o   Fall: September 1 through November 30 - whitebark pine season

The existing ICE9 software would require modification in order to make calculations and report results according to these new seasonal definitions. Also, there is considerable uncertainty regarding the breakdown of seasons for grizzly bear habitat use in the GYE. Much of the data used to derive seasonal parameters comes from scat analyses, and the scats are not statistically sampled. Only a minute proportion of the grizzly bear scats deposited annually in the GYE are collected and analyzed. Scat collections are not conducted at random sites and sampling biases are unknown (Picton pers. comm.)

Edge

Edge coefficients are relatively large values and concerns have been raised that these types of ecotones are being grossly inflated in habitat evaluations. This condition provides a classic example of how error propagation can bias model results (Picton pers. comm.) In 1996 Kim Barber conducted an analysis of the contribution of edge to habitat value and habitat effectiveness scores. Results of this analysis showed emphatically that edge is the primary contributor to habitat value.

Of the 13 Bear Management subunits tested, habitat value increased an average of 637% with edge factored into the equation. However, in most instances the rank of the subunit (based on annual HV) did not change, or changed no more than two places in rank with the inclusion of the edge factor. The implication of this finding is that with or

without edge the same interpretation would be made regarding the relative habitat value of these subunits (Barber 1996).

The exceptions of subunits that did change substantially in rank were Madison #2 (4th to 13th) and South Absaroka #1 (10th to 6th). Madison #2 is primarily in Yellowstone National Park and has very little edge based on the habitat mapping. Conversely, South Absaroka #1 is entirely on the Shoshone National Forest and has considerable edge based on the habitat mapping (Barber 1996). This condition could be a function of the different mapping standards and techniques employed by Yellowstone National Park and should be further reviewed.

At the meeting in June 1997 Mattson expressed confidence that his recent work (Mattson 1996, 1997) regarding bear use of ungulates and biscuitroot more accurately reflects the degree to which grizzly bears prefer forest - nonforest ecotones in the GYE than existing edge coefficients. This work suggests that an edge factor of 2 for both cover types and for all seasons is more appropriate for use with the CEM than the existing edge coefficients. The modeling team will use this new edge coefficient for future CEM runs.

Supplemental

Mattson's work at the University of Idaho has provided more information on grizzly bear use of animal food sources currently treated as supplemental habitat components in the CEM. For this research he created a GYE-wide map of ungulate winter ranges, primarily elk and bison, based on information gained from Yellowstone National Park and state wildlife management agencies.

Mattson indicated that additional research is needed to further assess the importance of various supplemental habitat components such as calving areas and summer/fall ungulate ranges, to develop new coefficients for these types. Additional research and further evaluation of the ungulate supplemental types is warranted because the original coefficients were developed with limited data, and mainly in response to discrepancies produced by using vegetation coefficients alone to account for bear densities in different BMUs. Fish and moth supplemental coefficients developed by Mattson (1993) were based on more recent data and will not be re-evaluated for the CEM at this time.

Disturbance

Model coefficients for disturbance from human activities were originally developed in 1984 using the best judgement of members of the CEM technical committee. With the conversion to fixed zones of influence in 1989, Mattson revised disturbance coefficients based on more recent studies of grizzly bear responses to human activities (Mattson pers. comm.) The modeling team agreed that these newer disturbance coefficients are more defensible than the original values. Mattson has agreed to provide documentation of the revision process, with references cited.

Mortality

Mortality coefficients need to be totally revisited and a new mortality routine developed for the CEM. Ecosystem-wide habitat and activities databases are available for use in developing new mortality coefficients. Ideas should be solicited for the conceptual development of a new mortality routine, looking beyond the modeling team and the GYE

for suggestions. A peer review of the CEM as described earlier would provide the breadth of experience and new ideas necessary to tackle this project. Future analyses for the mortality routine need to focus on calibrating coefficients to actual grizzly bear mortality rates so that model outputs can be interpreted in a meaningful way to estimate the probability of bear deaths attributable to certain types and densities of human activities.

Software

The software package which performs the calculations and produces both numeric and graphic results has been modified several times over the history of the CEM. The collective opinion of the modeling team is that the ICE9 program suite performs a faithful implementation of the CEM as conceptually designed. This opinion is largely based on comparisons of model outputs with independent biological assessments.

To date, there have been limited attempts to validate the software other than with standard code validation. Bevins conducted some simple tests while programming the model by constructing a 10 X 10 cell area with known vegetative value and applying activities one at a time. These test scenarios were run through the model and duplicated by hand with the same results (Bevins pers. comm.)

I conducted another basic test of the model and developed a paper schematic of my interpretation of how the CEM works (shown in Figures 11 and 13 and Tables 3 and 4 in Chapter 3). This paper exercise was reviewed by Bevins and deemed to be an accurate representation of how the ICE9 software performs the calculations for habitat value (HV) and habitat effectiveness (HE). These simple validation efforts combined with the intuitive

feelings of members of the modeling team indicate that the software is performing as expected. However, there has been no rigorous testing of the programs under complex habitat and activity conditions. Given the diversity of these conditions prevalent in the GYE, it would be wise to pursue further evaluation of the CEM software.

Documentation and Support

Although a user's guide (Bevins 1997) is available for the ICE9 software, there is currently no technical documentation of the code for the CEM programs, as this was not a requirement of the contract to obtain the current version of software. It is imperative to acquire technical documentation of the CEM code in order to conduct any serious validation efforts. Additionally, there is currently no official mechanism for obtaining computer support for ICE9 software as this function was also omitted from programming contract. Bevins has been very gracious about providing free computer support on an ad hoc basis; however, we cannot expect this type of service to continue. It is vital that we institute a formal agreement for technical support of the CEM software, be it from agency personnel or external sources. Limited funding may be a barrier to securing these types of services. Nevertheless, technical documentation and support of the computer software are critical aspects of the cumulative effects modeling effort.

Strategy for Future Development

Based on the above review and evaluation of the GYE CEM, we can begin to develop a strategy for future development of the model. Evolution of the model should

rely on differential emphasis of effort according to the varying degrees of importance of results. This section will outline the steps which I believe to be the critical path for development of the GYE CEM.

Population Viability Analysis

In order to conduct meaningful interpretations of CEM outputs, we musts be able to evaluate the results relative to demographics of the GYE grizzly bear population. This step requires an estimate of the number of reproductive animals necessary to enable long-term survival of the population. "Long-term" is a relative concept which must be defined by GYE managers based upon the desires of our human society to continue to allow the existence of grizzly bears in our midst. Population viability analysis (PVA) is used to determine the minimum number of animals necessary to sustain a viable population over a given time period with a specified probability of extinction (Soule 1987).

With an estimate of the minimum number of reproductive female grizzly bears required for survival of the population (for say 100 years with an extinction probability of 5%), we can use the CEM to assess the needs of this cohort by examining model output for known female home ranges. In this manner, we can estimate the minimum number of habitat unit days (HUD) required by successfully reproducing grizzly bears and use these estimates to establish thresholds of habitat effectiveness for the ecosystem.

Managers can use thresholds in the interpretation of CEM results as guidance for scheduling, placement and perhaps restriction of human activities across the entire ecosystem. PVA will provide information on grizzly bear mortality limits required to

sustain a viable population. This information will be crucial in the formation of a new mortality routine and the subsequent establishment of mortality thresholds as guidance for the interpretation of CEM output.

The US Fish and Wildlife Service Grizzly Bear Recovery Coordinator and the Interagency Grizzly Bear Study Team (IGBST) are currently coordinating the pursuit of a PVA for GYE grizzly bears. This work is to be contracted out to a group of biometricians. The estimated time frame for completion of the PVA is one year. The estimated time frame for analysis of female home ranges and establishment of habitat effectiveness thresholds based on the PVA results is two years.

Mortality Routine

Development of a new method for assessing the risk of grizzly bear mortality due to human activities is integral to our ability to perform cumulative effects assessments. Whether we incorporate this methodology into the CEM or develop it as a stand-alone model, we must have some means of evaluating the probability of grizzly bear deaths associated with various types and levels of human activities with the GYE.

The CEM database could provide information on habitat and human activity features for use in an analysis of GYE grizzly bear mortality data. Development of a new mortality routine is an interagency responsibility. Derivation of mortality variables (e.g. coefficients) and equations should be conducted with oversight by the IGBST, but may involve individuals from other agencies and the private sector as well. Estimated time for a complete, usable mortality routine is two to three years.

Sensitivity Analysis

Sensitivity testing of the model for each of the data layers (vegetation, supplemental, linear, point and dispersed) has been discussed as a way to evaluate the degree of contribution to model output for the various data types. Limited testing has already occurred with the ICE9 software. This version of the model is designed to provide a "snapshot" of the change in habitat value (HV) and habitat effectiveness (HE) with the addition of each data layer.

In order to evaluate the sensitivity of the model to different variables, model runs could be made under several different scenarios, altering the variables under each scenario and comparing results of the runs. The CEM merits a thorough sensitivity analysis, including consultation with a statistician, which has not been done. However, I believe the following crude analysis could be helpful in examination of the relative contribution of model variables.

First, select a sample of BMUs that provides a good general representation of the ecosystem for vegetative, supplemental and human use diversity. All administrative units should be represented in the sample in order to reflect differences in mapping and coding techniques. Next, use the ICE9 software to calculate habitat value and habitat effectiveness scores for each BMU under the following scenarios:

1. vegetation alone, excluding consideration of edge

2. vegetation with edge

3. vegetation with edge and supplemental

4. vegetation with supplemental and not edge

These scenarios will demonstrate the relative contribution of different factors considered in the habitat routine for computation of habitat value. In order to evaluate the relative contribution of model variables to habitat effectiveness, permutations of activity data layers could be added to the habitat value base as follows:

(P = point activities, L = linear activities and D = dispersed activities)

1. P	6. L	11. D
2. P, L	7. L, P	12. D, P
3. P, L, D	8. L, P, D	13. D, P, L
4. P, D	9. L, D	14. D, L
5. P, D, L	10. L, D, P	15. D, L, P

Running the above iterations through the model for a sample of several BMUs allows for comparison of outputs between runs for the same BMU to evaluate the relative contribution to habitat value and habitat effectiveness of the individual model variables as well as combinations of model variables. By comparing output between BMUs for the same run scenario, we can evaluate how the different combinations of variables affect the rank of the BMUs in terms of habitat value and habitat effectiveness scores.

Using the completed GYE database, this type of sensitivity analysis could be conducted within a years time. I would also recommend that further, more sophisticated sensitivity testing be conducted on CEM with the advice and assistance of a statistician. Once sensitivity tests are complete and results analyzed, the CEM could potentially be simplified by eliminating variables determined to have little or no effect on model output.

Data Updates

An important aspect of CEM development is establishment of a system and schedule for data updates. Modeling techniques described earlier in this chapter have potential for improving the accuracy of the *existing* vegetation database, but there is still a need for a method to update the database for changes in vegetation over time due to succession and disturbance. Satellite imagery shows promise for modeling both types of vegetative changes. The mechanism for modeling vegetation change due to disturbance has already been developed through the 1988 fire update modeling effort. Successional change in vegetation has been described for the GYE by various authors (Romme 1982, Despain 1990, Anderson 1994 and Ament 1995). These works could provide valuable information and potential methods for developing an update system for the CEM vegetation database.

Within a year, the modeling team should develop a schedule for administrative units to update data and a process for transferring updates to the database coordinator. Under this system, supplemental habitat data layers should be periodically reviewed with State and National Park wildlife biologists and updated accordingly. As human land use patterns are quite dynamic in the GYE, activities data should be reviewed annually and updated as necessary. Incorporation of USGS cartographic feature files into the linear activity database would improve accuracy and consistency in the corporate database. This process has been completed for the Gallatin National Forest and will likely take one to two years to complete for the rest of the ecosystem.

Coefficient Updates

A system for revision of model coefficients is necessary in order to remain current with research and technology. This process is already starting to occur for GYE CEM coefficients. Mattson has been commissioned to revise the vegetation coefficients using a complete data set for the GYE beginning in 1998. This process is estimated to take six to twelve months. The modeling team will likely adopt Mattson's suggestion for new edge coefficients by the end of 1997. Disturbance coefficients were updated by Mattson in 1989. The IGBST should be responsible for informing the modeling team and GYE managers when new, relevant information is produced, and should also have the lead in updating coefficients.

Conclusion

The completion of the CEM database and the availability of a fast, efficient, user-friendly computer system foretell challenging times for the future of grizzly bear habitat modeling in the GYE. Validation efforts on all aspects of the model can now be pursued. CEM data and the habitat evaluation routines can be used to facilitate the design of a new mortality routine. Model outputs for known female home ranges could be used to further assess the needs, and the capability of the GYE to support, this critical grizzly bear cohort. We can begin to update and revise coefficients that are long past due.

Most importantly, use of the CEM on an ecosystem wide basis to evaluate long term trends in grizzly bear habitat effectiveness relative to stated grizzly bear recovery goals is now possible. As we grow to better understand and increase our ability to

interpret the outputs of the CEM we can perhaps *cautiously* begin to use the model for incremental effects analysis at the project level for purposes of optimizing the placement and scheduling of human activities.

There is support for the CEM from the Yellowstone Grizzly Bear Subcommittee and members of the GYE modeling team. Without this support the CEM would likely cease to exist. Future development and use of the model hinge on continued commitment and funding of critical efforts associated with the CEM as described in this document.

Communication of CEM processes and development has been somewhat limited in the past. It is imperative that such pertinent information receives widespread attention. Managers and agency representatives need to have a basic understanding of the model, the data it runs on, and the output it provides so that they can utilize model results in a responsible manner and explain the modeling process to interested publics. Biologists should gain a better understanding of model operations so that they can properly interpret outputs for biological assessments and provide appropriate input for management decisions.

A more thorough job of communicating the CEM's abilities and limitations to the general public and scientific community is necessary to gain acceptance and support for the application of CEM. This thesis provides a source for increasing knowledge and awareness of the CEM as a tool for grizzly bear management in the GYE. Once people come to understand the complexities of the CEM they will hopefully appreciate it for the remarkable tool that it is.

REFERENCES CITED

Ament, R.J. 1995. Pioneer Plant Communities Five Years After the 1988 Yellowstone Fires. M.S. Thesis, Montana State University, Bozeman. 216 p.

Anderson, N.J. 1994. Grizzly Bear Food Production on Clearcuts within the Western and Northwestern Yellowstone Ecosystem. M.S. Thesis, Montana State University, Bozeman. 73 p.

Barber, K.R. 1996. Yellowstone Modeling Team meeting notes. October 1996.

Barber, K.R. 1997. Yellowstone Modeling Team meeting notes. June 1997.

Bevins, C.D. 1988. The State of CEM. Unpublished report to the US Forest Service National Grizzly Bear Habitat Coordinator. 7 p.

Bevins, C.D. 1989. Comparison of Zone-of-Influence Computation Methods. Analysis results presented to Yellowstone modeling team October 1989. 4 p.

Bevins, C.D. 1991. The ICE Tool Kit: Software Tools for Incremental Cumulative Effects Analysis. Unpublished users guide for CEM software. 28 p.

Bevins, C.D. 1997. ICE9 User's Guide & Arm Chair Companion. Unpublished Cumulative Effects Analysis Software Documentation. Release 1.1. April 1, 1997.

Blanchard, B.M. 1983. Grizzly Bear Habitat Relationships in the Yellowstone Area. Int. Conf. Bear Res. and manage. 5:118-123.

Breazeale, R. 1984. Letter from Robert E. Breazeale, Forest Supervisor, Gallatin National Forest, to reviewing agents with draft copies of Cumulative Effects Analysis Process for the Yellowstone Ecosystem. Dated October 22, 1984.

Brannon, R. 1984. Influence of Roads and Developments on Grizzly Bears in Yellowstone National Park. IGBST Report.

Christensen, A., and M. Madel. 1982. Cumulative effects analysis process - grizzly habitat component mapping. USDA Forest Service, Kootenai National Forest, Libby, MT. 60 p.

Daubenmire, R. 1966. Vegetation: identification of typal communities. Science 151:291-298.

Dawkins, R. 1989. The Selfish Gene, New Edition. Oxford University Press. Oxford, NY

Despain, D.G. 1977. Forest Successional Stages in Yellowstone National Park. USDI, National Park Service, Yellowstone National Park. Unpublished Info. Paper. 3 p.

Despain, D.G. 1990. Yellowstone Vegetation: Consequences of Environment and History in a Natural Setting. Roberts and Rinehart Publishing. Boulder, CO.

Dixon, B. 1989. Comparison of Grizzly Bear Cumulative Effects Assessment Models. Unpublished report to Cumulative Effects Modeling teams. USDA Forest Service, Gallatin National Forest. Dated March 27, 1989. 10 p.

Dixon, B. and K. Barber. 1995. Yellowstone Modeling Team meeting notes. February 1995.

Endangered Species Act (ESA), 1973. 50 CFR, Part 402.

Escano, R.E. 1986. Grizzly Bear Cumulative Effects Model Comparison. Unpublished report. USDA Forest Service, Region 1. Dated January 21, 1986.

Graham, D.C. 1978. Grizzly Bear Distribution, Use of Habitats, Food Habits and Habitat Characteristics in Pelican and Hayden Valleys, Yellowstone National Park. M.S. Thesis, Montana State University, Bozeman.

Grotzinger, T.A. 1987. Ski Yellowstone Biological Assessment: Final. USDA Forest Service. Gallatin National Forest. 120 p.

Knight, R.R. 1996. Letter to the Yellowstone Grizzly Bear Subcommittee regarding challenges with the GYE CEM. Dated August 19, 1996.

Knight, R.R. and L.L. Eberhardt. 1985. Population Dynamics of Yellowstone Grizzly Bears. Ecology 66(2):323-334.

Mace, R.D., J.S. Waller, T.L. Manley, L.J. Lyon and H.Zuuring. 1996. Relationships Among Grizzly Bears, Roads and Habitat in the Swan Mountains, Montana. J. Applied Ecol. 33:1395-1404.

Manly, B.F., L.L. McDonald and D.L. Thomas. 1993. Resource Selection by Animals. Statistical Design and Analysis for Field Studies. Chapman and Hall. London.

Mattson, D.J. 1993a. Cumulative Effects Analysis for the Yellowstone Grizzly Bear Population. Unpublished white paper. 7 p.

Mattson, D.J. 1993b. Zones of Influence and Habitat Effectiveness Coefficients for Moth Sites and Cutthroat Trout Spawning Streams in the Yellowstone Area. Unpublished white paper. 2 p.

Mattson, D.J. 1996. Use of Ungulates by Yellowstone Grizzly Bears. Biological Conservation. 78 (1996) 17 p.

Mattson, D.J. 1997. Selection of Microsites by Grizzly Bears to Excavate Biscuitroots. J. Mammal. 78(1):228-238.

Mattson, D.J. and D.G. Despain. 1985. Grizzly Bear Habitat Component Mapping Handbook for the Yellowstone Ecosystem. Unpublished document. 37 p.

Mattson, D.J. and R.R. Knight. 1991. Application of Cumulative Effects Analysis to the Yellowstone Grizzly Bear Population. USDI Natl. Park Serv. Interagency Grizzly Bear Study Team Report. 1991C.

Mattson D.J., R.R. Knight and B.M. Blanchard. 1986. Derivation of Habitat Component Values for the Yellowstone Grizzly Bear. *In:* Proceedings - Grizzly Bear Habitat Symposium. G. Contreras and K. Evans, Eds. USDA Forest Service, Intermountain Res. Sta. Ogden, Utah. Gen. Tech. Rep. INT-207. pp. 222-229.

Mattson, D.J., R.R. Knight and B.M. Blanchard. 1986. The Effects of Developments and Primary Roads on Grizzly Bear Habitat Use in Yellowstone National Park, Wyoming. Int. Conf. Bear Res. and Manage. 7:259-273.

Maw, R. and K. Barber. 1995. Statement of Charter for Yellowstone Modeling Team. Yellowstone Modeling Team meeting notes. August 1995.

National Environmental Policy Act (NEPA), 1969. 40 CFR, Part 1508.7

National Forest Management Act (NFMA), 1976. 36 CFR, Part 219.19

Pfister, R., B. Kovalchick, S. Arno, and R. Presby. 1977. Forest habitat types of Montana. USDA Forest Service Gen. Tech. Rept. INT-34.

Puchlerz, T. 1984. Grizzly Bear Cumulative Effects. A letter to CEM Task Force Members from Chairman. Dated March 2, 1984. 4 p.

Puchlerz, T. 1985. Interoffice Memo to Reid Jackson, Forest Supervisor, Bridger-Teton National Forest, Yellowstone Ecosystem Subcommittee Chairman, regarding Yellowstone Cumulative Effects Model. Dated May 24, 1985. 3 p.

Puchlerz, T., and J. Weaver. 1987. A Review of the Yellowstone Cumulative Effects Analysis Process. An internal report to the Yellowstone Ecosystem Grizzly Bear Subcommittee.

Ramsey, D., D. Winn, R. Maw, A. Falsoner and T. Van Niel. 1991. Fire Modification of the Greater Yellowstone Grizzly Bear Recovery Zone. Final Report to the Yellowstone Ecosystem Grizzly Bear Subcommittee. 24 p.

Romme, W.H. 1982. Fire and Landscape Diversity in Subalpine Forests of Yellowstone National Park. Ecological Monographs. 52:199-221.

Richardson, R. 1991. Summary of CEM Mortality Routine Meeting. Letter to Modeling Team Leaders dated May 29, 1991. 2 p.

Schleyer, B.O., J.J. Jonkel, K.G. Rhoades and D.M. Dunbar. 1984. The Effects of Recreation on Grizzly Bear Behavior and Habitat Use. IGBST Report.

Shannon, C.E. and W. Weaver. 1963. The Mathematical Theory of Communication. University of Illinois Press. Urbana, IL. 117 p.

Sidle, W.B. 1987. A Review of Cumulative Effects Analysis for Grizzly Bear in the Northern Region. A report to Director of Wildlife and Fisheries, Norther Region, USDA Forest Service. Dated July 23, 1987.

Soule, M.E., ed. 1987. Viable Populations. Cambridge Univ. Press, New York, NY.

Starfield, A.M. and A.L. Bleloch. 1986. Building Models for Conservation and Wildlife Management. Macmillan Publishing Company. New York.

Starfield, A.M. 1997. A pragmatic approach to modeling for wildlife management. J. Wildl. Manage. 61(2):261-270.

Steele, R., S. Cooper, D. Ondov, D. Roberts, and R. Pfister. 1983. Forest habitat types of eastern Idaho and western Wyoming. USDA Forest Service Gen. Tech. Rept. INT-144

USDA, Forest Service. 1984. Yellowstone Ecosystem Management Subcommittee Report. Unpublished notes to file dated April 2, 1984. 17 p.

USDA, Forest Service. 1985. Cumulative Effects Analysis Process for the Yellowstone Ecosystem. Unpublished Report. 40 p.

USDA, Forest Service. 1987. Thresholds for Habitat Effectiveness. Grizzly Bears - Greater Yellowstone Ecosystem. File copy dated December 15, 1987. 7 p.

USDA, Forest Serivce. 1988. Warm River Drainage Cumulative Effects Study of Timber Harvesting in Management Area 9. Targhee Natl. For. Ashton Ranger Dist. 288 p.

USDA, Forest Service. 1990. CEM — A Model for Assessing Effects on Grizzly Bears. Unpublished Report. 24 p.

USDA, Forest Service and USDI Park Service. 1979. Guidelines for Management Involving Grizzly Bears in the Greater Yellowstone Area.

USDA, Forest Serivce and USDI Park Service. 1994. Interagency Grizzly Bear Committee Taskforce Report: Grizzly Bear/Motorized Access Management. Unpublished document describing access standard definitions. Dated 2/24/95.

USDI, National Park Service. 1986. Categorization of human activities in Yellowstone National Park for Cumulative Effects Model. Unpublished diagram. Dated 3/25/86.

USDI, National Park Service. 1988. Final Environmental Impact Statement: Development Concept Plan - Fishing Bridge Developed Area, Yellowstone National Park. Denver, Colorado. 430 p.

Weaver, J. 1987. Update on Cumulative Effects Assessment Involving Grizzly Bears. Letter to Forest Supervisors, IGBC, Subcommittees and Staff Directors of USFS Regions 1, 2, 4 and 6, from USFS Grizzly Bear Habitat Coordinator. Dated October 15, 1987. 3 p.

Weaver, J. 1988. Grizzly Bear Cumulative Effects Assessment Thresholds for Habitat Effectiveness - Synopsis of Comments. Letter to file and grizzly bear management agencies from USFS Grizzly Bear Habitat Coordinator. Dated April 13, 1988. 13 p.

Weaver, J., R. Escano and D. Winn. 1985. A Framework for Assessing Cumulative Effects on Grizzly Bears. in:Trans. 52nd N.A. Wildl. & Nat. Res. Conf. p. 364-376.

Winn, D.S. and K.R. Barber. 1985. Cartographic Modeling: A Method of Cumulative Effects Appraisal. In: Proceedings - Grizzly Bear Habitat Symposium. G. Contreras and K. Evans, Eds. USDA Forest Service, Intermountain Res. Sta. Ogden, Utah. Gen. Tech. Rep. INT-207. p 247-252.

APPENDICES

APPENDIX A

YELLOWSTONE MODELING TEAM

Appendix A

Members of Cumulative Effects Modeling Teams

1984 to 1997

Ad Hoc Work Group: Est. January 1984
     John Drake (Chairman), Gallatin National Forest Supervisor
     Robert Barbee, Yellowstone National Park Superintendent
     John Burns, Targhee National Forest Supervisor
     Steve Mealey, Shoshone National Forest Supervisor
     Wayne Brewster, US Fish and Wildlife Service

Task Force: Est. January 1984
     Tom Puchlerz (Chairman), Resource Assistant, Gallatin National Forest
     Dave Henry, Wildlife Biologist, Shoshone National Forest
     John Weaver, T&E Species Biologist, Bridger-Teton National Forest
     Mark Orme, Wildlife Biologist, Targhee National Forest
     John McGee, Resource Assistant, Targhee National Forest
     John Edwards, Wildlife Biologist, Custer National Forest
     Don Despain, Plant Ecologist, Yellowstone National Park
     Glen Erickson, Wildlife Biologist, Montana F.W.&P, Helena, MT
     Dale Harms, T&E Species Biologist, US Fish & Wildlife Service, Helena, MT
     David Mattson, Research Biologist, IGBST
     Jon Swenson, Wildlife Biologist, Livingston, MT

Technical Committee: 1984-1987
     Tom Puchlerz (Chairman), Gallatin National Forest
     John Weaver, Bridger-Teton National Forest
     Ron Escano, USDA Forest Service, Region 1
     David Mattson, IGBST
     Don Despain, Yellowstone National Park
     Dave Winn, USDA Forest Service, Region 4

Yellowstone Modeling Team: 1988 - present
　　　　*Kim Barber, Shoshone National Forest (co-Team Leader 1995 - present)
　　　　*Roy Renkin, Yellowstone National Park (co-Team Leader 1995 - present)
　　　　*Bev Dixon, Gallatin National Forest (Team Leader 1988 - 1995)
　　　　Carol Eckert, Bridger-Teton National Forest
　　　　Dave Henry, Shoshone National Forest
　　　　Ann Mebane, Shoshone National Forest
　　　　Dave Winn, USDA Forest Service, Region 4
　　　　Melanie Woolever, USDA Forest Service, Region 2
　　　　David Mattson, IGBST
　　　　Hal Gibbs, Targhee National Forest
　　　　Pat Key, Targhee National Forest
　　　　Timm Kaminski, Targhee National Forest
　　　　Don Despain, Yellowstone National Park
　　　　Jane Royball, US Fish & Wildlife Service, Cheyenne, WY
　　　　Scott Jackson, US Fish & Wildlife Service, Helena, MT
　　　　Fred Straus, Targhee National Forest
　　　　*Steve Cain, Grand Teton National Park
　　　　*Bill Noblitt, Bridger-Teton National Forest
　　　　*Ron Wiseman, Beaverhead-Deerlodge National Forest
　　　　*Roger Swalley, IGBST
　　　　*Shannon Podruzny, IGBST
　　　　*Anne Vandehey, US Fish & Wildlife Service, Helena, MT
Technical Support:
　　　　*Ralene Maw, Forest Service, Region 4 (Database Coordinator 1994 - present)
　　　　*Larry Warren, Bridger-Teton National Forest (GIS advisor)
　　　　*Sue Fullerton, Grand Teton National Park (GIS advisor)
　　　　*Doug Ouren, IGBST, (GIS/Modeling advisor)
　　　　*Collin Bevins, Systems for Environmental Management, Missoula, MT
　　　　　　　　(CEM programmer, Modeling advisor 1988 - present)

* Current YMT members (as of November, 1997)

APPENDIX B

MODEL COEFFICIENTS

VEGETATION COEFFICIENTS

```
##############################################################################
#
#   Vegetation Class Table
#   Greater Yellowstone Ecosystem
#   Last modified on Jan 9, 1997 by Collin D. Bevins
#
##############################################################################
#
# Coefficients for vegetation
#     by C. Bevins, March 1991
#
# Updated with new coefficients from D. Mattson January 1994
#     by B. Dixon, April 1994
#
# Updated with new class boundaries and values using area weighting.
#     by C. Bevins, May 1994 (CDB)
#
# New codes added 9/28/95 (BGD).  Coefficients extrapolated from
#     existing values assigned to "like" HC types.
#
# Added codes 91190-91394 on 1/10/96 Cottonwood types added to reflect
#  types on the Grand Teton National Park.  All cottonwood types eslewhere
#  were mapped as 91169.  Mattson developed the coefficients for 91169.  For
#  the 911-913 codes the coefficients for 91169 were used for all types.
#  Need to get Mattson to evaluate these codes at a future date (KRB).
#
# Added code 00099 on 1/16/96 for moth sites (KRB).
#
# New codes were added by Kim Barber on 1/18/96 to accommodate types on the
#  Targhee NF not previously found in this file.  Coefficients were
#  developed by the Targhee NF from habitat types with similar overstory
#  and/or understory and/or successional stage.  Process documented in a
#  report by Mark Orme dated 1/12/96 (TNF).
#
# Updated by Kim Barber on 2/20/96 using instructions from Dave Mattson
#  (April 1994).  Involved extrapolating from like habitat types.  Complete
#  documentation on file (KRB2).
#
# New codes added by Ralene Maw (RWM) on 5/8/96.  Codes 010 were added.  These
#  represent talus and are unique to Region 1 only.  Coefficients from 00053
#  (talus) were used for all types.  Codes 41090-41093 and 44090-44093 were
#  added.  These were Cottonwood types added to again reflect types on the
#  Grand Teton National Park.  Coefficient for 91169 was used for all types.
#
#     CDB = Collin Bevins
#     BGD = Bev Dixon
#     TNF = Targhee NF
#     KRB = K. Barber
#     RWM = R. Maw
```

```
# "WITHOUT UNGULATES" vegetation coefficients to be used in BMUs or
# Subunits that meet the following criteria: (per D.Mattson 6/17/93)
#        < 10 bison per 100 km sq. (25.9 bison/100 mi sq)
#      AND < 250 elk per 100 km sq. (647.7 elk/100 mi sq)
# during all seasons (spring, summer and fall).
#
#################################################################################
#
#  Seasons Record
#     The seasons specified here are used only to expand the HQ coeffs into
#     full HQ calendars, and need NOT be the same seasons used to
#     summarize HQ, HV, HE into seasonal totals.
#
#        So here is the "season" record for this file:
#     <sprBeg> <sprEnd> <smrBeg> <smrEnd> <fallBeg> <fallEnd>
seasons:  0301    0531     0601     0831      0901     1130
#
#-----------------------------------------------------------------------------
#
#  Weights Record
#     Weights are used to determine weighted HQ coefficients for mosaic types.
#     A maximum of four codes are permitted per feature.
#
#        So here is the "weights" record for this file:
#        1st Hab  2nd Hab  3rd Hab  4th Hab
weights:     4        3        2        1
#
#-----------------------------------------------------------------------------
#
#  Class Records
#     Class records define each veg type and have 11 fields.
#
#     Fld  Contents  Description
#     ---  --------  ---------------------------------------------------
#
#      1 count    number [1..65535] (try to keep consecutive & low)
#      2 subject  5-digit habitat type code
#      3 cover    Cover codes are
#                    1 = Removed Cover
#                    2 = Low Cover
#                    3 = Low / High Mosaic Cover
#                    4 = High / Low Mosaic Cover
#                    5 = High Cover
#      4 spr0     Spring VC for subunits WITHOUT ungulates
#      5 smr0     Summer VC for subunits WITHOUT ungulates
#      6 fal0     Fall VC for subunits WITHOUT ungulates
#      7 spr1     Spring HQ for subunits WITH ungulates
#      8 smr1     Summer HQ for subunits WITH ungulates
#      9 fal1     Fall  HQ for subunits WITH ungulates
#     10  desc    Description (enclosed in quotes)
#
```

#	Code	Cov	--With Out Ungulates--			----With Ungulates----			Description
			Spring	Summer	Fall	Spring	Summer	Fall	
1	00011	2	0.2900	0.1880	0.4600	0.4600	0.2170	0.4590	"LOW TALL SHRUB COMM"
2	00012	2	0.4770	0.2820	0.3810	0.4760	0.3220	0.5560	"MST SAGE/CINQUEFOIL"
3	00013	2	0.1660	0.2240	0.0001	0.2780	0.2570	0.0001	"DRY SAGE"
4	00014	2	0.0001	0.1440	0.0001	0.0001	0.1640	0.0001	"LOW WILLOW"
5	00015	2	0.3220	0.2530	0.1900	0.3770	0.2900	0.2780	"ROCKY MOIST SAGE"
6	00021	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"FORB SEEP"
7	00022	2	0.0001	0.1490	0.0001	0.0001	0.1710	0.0001	"WET FORB MEADOW"
8	00023	2	0.0700	0.1650	0.0001	0.0670	0.1880	0.0001	"MOIST FORB MEADOW"
9	00024	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"DRY FORB MEADOW"
10	00031	2	0.3580	0.0001	0.5000	0.5430	0.0001	0.8330	"LOW MARSH/FEN"
11	00032	2	0.0780	0.2070	0.0940	0.1560	0.2350	0.1020	"LOW WET GRASSLAND"
12	00033	2	0.5140	0.2740	0.4960	0.4740	0.3000	0.4800	"LOW MOIST GRASSLAND"
13	00034	2	0.0910	0.1060	0.0001	0.0870	0.1220	0.0001	"HIGH ROCKY GRASSLAND"
14	00035	2	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"DRY GRASSLAND"
15	00041	2	0.0001	0.2790	0.0001	0.0001	0.3200	0.0001	"WET OPENING"
16	00042	2	0.0700	0.1650	0.0001	0.0670	0.1880	0.0001	"MOIST/DRY OPENING"
17	00051	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TUNDRA"
18	00052	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"EXPOSED BEDROCK"
19	00053	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS"
20	00054	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"STREAM COURSE"
21	00055	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"STANDING WATER"
22	00056	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"CLIFFS"
23	00057	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"SHRUB AVAL CHUTE"
24	00058	2	0.0001	0.0001	0.1490	0.0001	0.1710	0.0001	"GRAM/FORB AVAL CHUTE"
25	00059	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"AGRICULTURAL AREAS"
26	00060	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"URBANIZED AREAS"
27	00071	2	0.0001	0.1110	0.1270	0.0001	0.1280	0.3590	"HIGH MARSH/FEN"
28	00072	2	0.0001	0.1260	0.0001	0.0001	0.1440	0.0001	"HIGH WET GRASSLAND"
29	00073	2	0.0001	0.2580	0.4780	0.0001	0.2410	0.4690	"HIGH MOIST GRASSLAND"
30	00074	2	0.4380	0.1290	0.0001	0.4080	0.1490	0.0001	"HIGH DRY FORB MEADOW"
31	00081	2	0.0001	0.1290	0.0001	0.0001	0.1490	0.0001	"HIGH TALL SHRUB COMM"
32	00082	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"HIGH WET FORB MEADOW"
33	00099	2	0.0001	0.5000	0.0001	0.0001	0.5000	0.0001	"MOTH SITES (KRB)"
34	01023	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
35	01024	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
36	01044	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
37	01050	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
38	01051	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
39	01054	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
40	01070	2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	"TALUS (RWM)"
41	04064	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/AGSP:OW (BGD)"
42	05010	1	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:LI0 (CDB)"
43	05013	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:LI3"
44	05060	1	0.0001	0.1080	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:KRB (KRB2)"
45	05061	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:OWB (CDB)"
46	05064	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:OW"
47	05084	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID:MF (BGD)"
48	05113	5	0.0001	0.0930	0.0001	0.0001	0.1080	0.0001	"PIFL/FEID-FEID:LI3"

```
49 05114 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID-FEID:LI"
50 05164 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID-FEID:OW (BGD)"
51 07014 5 0.0830 0.0070 0.0001 0.0900 0.0080 0.0001  "PIFL/JUCO:LI"
52 07023 5 0.0830 0.0070 0.0001 0.0900 0.0080 0.0001  "PIFL/JUCO:DF3 (BGD)"
53 07064 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/JUCO:OW (BGD)"
54 08013 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/HEKI:LI3"
55 08020 1 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/HEKI:DF0"
56 08024 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PIFL/HEKI:DF"
57 08060 1 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/HEKI:KRB (CDB)"
58 08063 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/HEKI:KR"
59 08064 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/HEKI:OW"
60 08081 5 0.0480 0.0300 0.0001 0.0530 0.0720 0.0001  "PIFL/HEKI:MF1"
61 09224 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID:DF"
62 09234 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID:LP"
63 09323 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID-FEID:DF3"
64 09324 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PIFL/FEID-FEID:DF"
65 09524 5 0.0830 0.0070 0.0001 0.0900 0.0080 0.0001  "PIFL/JUCO:DF"
66 21013 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/AGSP:LI3 (BGD)"
67 21022 5 0.0560 0.0360 0.0001 0.0620 0.0890 0.0001  "PSME/AGSP:DF2"
68 21023 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/AGSP:DF3"
69 21024 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/AGSP:DF (BGD)"
70 21064 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/AGSP:OW"
71 21072 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001  "PSME/AGSP:ASP2"
72 22013 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/FEID:LI3"
73 22020 1 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/FEID:DF0"
74 22021 5 0.0480 0.0300 0.0001 0.0530 0.0720 0.0001  "PSME/FEID:DF1"
75 22022 5 0.0560 0.0360 0.0001 0.0620 0.0890 0.0001  "PSME/FEID:DF2"
76 22023 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/FEID:DF3"
77 22024 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/FEID:DF"
78 22030 1 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/FEID:LP0"
79 22033 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/FEID:LP3"
80 22034 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/FEID:LP4"
81 22064 5 0.0001 0.0930 0.0001 0.0001 0.1080 0.0001  "PSME/FEID:OW"
82 22073 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001  "PSME/FEID:ASP3 (BGD)"
83 22132 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001  "PSME/FEID-FEID:LP2 (BGD)"
84 26020 1 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001  "PSME/PHMA:DF0 (CDB)"
85 26021 5 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001  "PSME/PHMA:DF1"
86 26022 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001  "PSME/PHMA:DF2"
87 26024 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA:DF"
88 26032 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001  "PSME/PHMA:LP2"
89 26064 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA:OW"
90 26113 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA-PHMA:LI3 (BGD)"
91 26114 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA-PHMA:LI"
92 26120 1 0.0040 0.0080 0.0001 0.0530 0.0410 0.0001  "PSME/PHMA-PHMA:DF0 (BGD)
93 26121 5 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001  "PSME/PHMA-PHMA:DF1"
94 26122 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001  "PSME/PHMA-PHMA:DF2"
95 26123 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA-PHMA:DF3"
96 26124 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001  "PSME/PHMA-PHMA:DF"
97 26132 5 0.0009 0.0130 0.0001 0.1220 0.0710 0.0001  "PSME/PHMA-PHMA:LP2"
98 26133 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001  "PSME/PHMA-PHMA:LP3"
99 26222 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001  "PSME/PHMA-CARU:DF2"
```

```
100 26223 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/PHMA-CARU:DF3"
101 26273 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/PHMA-CARU:ASP3"
102 28020 1 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL:DF0"
103 28021 5 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL:DF1"
104 28022 5 0.0001 0.0550 0.0001 0.0001 0.0590 0.0001 "PSME/VAGL:DF2"
105 28023 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/VAGL:DF3"
106 28024 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/VAGL:DF"
107 28030 1 0.0001 0.1060 0.0001 0.0001 0.1060 0.0001 "PSME/VAGL:LP0"
108 28031 5 0.0001 0.1060 0.0001 0.0001 0.0720 0.0001 "PSME/VAGL:LP1"
109 28032 5 0.0001 0.0790 0.0001 0.0001 0.0810 0.0001 "PSME/VAGL:LP2"
110 28033 5 0.0001 0.0930 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:LP3"
111 28034 5 0.0001 0.0930 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:LP"
112 28040 1 0.0001 0.1060 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:SF0"
113 28041 5 0.0001 0.1060 0.0001 0.0001 0.0720 0.0001 "PSME/VAGL:SF1"
114 28042 5 0.0001 0.0790 0.0001 0.0001 0.0810 0.0001 "PSME/VAGL:SF2"
115 28070 1 0.0001 0.0100 0.0001 0.0001 0.0040 0.0001 "PSME/VAGL:ASP0"
116 28071 5 0.0001 0.0100 0.0001 0.0001 0.0040 0.0001 "PSME/VAGL:ASP1"
117 28072 5 0.0001 0.0700 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:ASP2"
118 28073 5 0.0001 0.0700 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:ASP3"
119 28074 5 0.0001 0.0700 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL:ASP"
120 28120 1 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL-VAGL:DF0"
121 28121 5 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL-VAGL:DF1"
122 28122 5 0.0001 0.0550 0.0001 0.0001 0.0590 0.0001 "PSME/VAGL-VAGL:DF2"
123 28123 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/VAGL-VAGL:DF3"
124 28124 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/VAGL-VAGL:DF"
125 28130 1 0.0001 0.1060 0.0001 0.0001 0.0600 0.0001 "PSME/VAGL-VAGL:LP0"
126 28131 5 0.0001 0.1060 0.0001 0.0001 0.0720 0.0001 "PSME/VAGL-VAGL:LP1"
127 28132 5 0.0001 0.0790 0.0001 0.0001 0.0810 0.0001 "PSME/VAGL-VAGL:LP2"
128 28133 5 0.0001 0.0930 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:LP3"
129 28134 5 0.0001 0.0930 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:LP"
130 28140 1 0.0001 0.1060 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:SF0"
131 28141 5 0.0001 0.1060 0.0001 0.0001 0.0720 0.0001 "PSME/VAGL-VAGL:SF1"
132 28142 5 0.0001 0.0790 0.0001 0.0001 0.0810 0.0001 "PSME/VAGL-VAGL:SF2"
133 28170 1 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL-VAGL:ASP0"
134 28171 5 0.0001 0.0500 0.0001 0.0001 0.0470 0.0001 "PSME/VAGL-VAGL:ASP1"
135 28172 5 0.0001 0.0500 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:ASP2"
136 28173 5 0.0001 0.0500 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:ASP3"
137 28174 5 0.0001 0.0700 0.0001 0.0001 0.0660 0.0001 "PSME/VAGL-VAGL:ASP"
138 28184 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/VAGL-VAGL:MF (BGD)"
139 28330 1 0.0001 0.1060 0.0001 0.0001 0.0600 0.0001 "PSME/VAGL-XETE:LP0"
140 29122 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/LIBO-SYAL:DF2"
141 29132 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/LIBO-SYAL:LP2"
142 29213 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/LIBO-CARU:LI3 (BGD)"
143 29222 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/LIBO-CARU:DF2 (BGD)"
144 29232 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/LIBO-CARU:LP2 (BGD)"
145 29264 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/LIBO-CARU:OW (BGD)"
146 29322 5 0.0001 0.0550 0.0001 0.0001 0.0590 0.0001 "PSME/LIBO-VAGL:DF2 (BGD)"
147 29323 5 0.0001 0.0600 0.0001 0.0001 0.0700 0.0001 "PSME/LIBO-VAGL:DF3"
148 29332 5 0.0001 0.0790 0.0001 0.0001 0.0810 0.0001 "PSME/LIBO-VAGL:LP2"
149 31020 1 0.0040 0.0080 0.0001 0.0530 0.0410 0.0001 "PSME/SYAL:DF0"
150 31021 5 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001 "PSME/SYAL:DF1"
```

```
151 31022 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/SYAL:DF2"
152 31023 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL:DF3"
153 31024 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL:DF"
154 31030 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL:LP0"
155 31031 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL:LP1"
156 31032 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/SYAL:LP2"
157 31033 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL:LP3"
158 31034 5 0.0001 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL:LP"
159 31040 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL:SF0"
160 31041 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL:SF1"
161 31042 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/SYAL:SF2"
162 31070 1 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL:ASP0"
163 31071 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL:ASP1"
164 31072 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL:ASP2"
165 31073 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL:ASP3"
166 31074 5 0.0060 0.0120 0.0001 0.1820 0.0570 0.0001 "PSME/SYAL:ASP"
167 31081 5 0.0400 0.0080 0.0001 0.1700 0.0410 0.0001 "PSME/SYAL:MF1"
168 31121 5 0.0480 0.0300 0.0001 0.0530 0.0720 0.0001 "PSME/SYAL-AGSP:DF1"
169 31122 5 0.0560 0.0360 0.0001 0.0620 0.0890 0.0001 "PSME/SYAL-AGSP:DF2"
170 31123 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001 "PSME/SYAL-AGSP:DF3"
171 31124 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001 "PSME/SYAL-AGSP:DF"
172 31132 5 0.0560 0.0360 0.0001 0.0620 0.0890 0.0001 "PSME/SYAL-AGSP:LP2"
173 31220 1 0.0040 0.0080 0.0001 0.0530 0.0410 0.0001 "PSME/SYAL-CARU:DF0"
174 31221 5 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001 "PSME/SYAL-CARU:DF1"
175 31222 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/SYAL-CARU:DF2"
176 31223 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-CARU:DF3"
177 31224 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-CARU:DF"
178 31230 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL-CARU:LP0"
179 31231 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL-CARU:LP1"
180 31232 5 0.0090 0.0130 0.0001 0.1120 0.0710 0.0001 "PSME/SYAL-CARU:LP2"
181 31233 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL-CARU:LP3"
182 31234 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL-CARU:LP"
183 31240 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL-CARU:SF0"
184 31241 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL-CARU:SF1"
185 31242 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/SYAL-CARU:SF2"
186 31244 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYAL-CARU:SF
187 31251 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYAL-CARU:WB1
188 31270 1 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-CARU:ASP0"
189 31271 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-CARU:ASP1"
190 31272 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-CARU:ASP2"
191 31273 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-CARU:ASP3"
192 31274 5 0.0060 0.0120 0.0001 0.1820 0.0570 0.0001 "PSME/SYAL-CARU:ASP"
193 31284 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-CARU:MF"
194 31313 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-SYAL:LI3"
195 31320 1 0.0040 0.0080 0.0001 0.0530 0.0410 0.0001 "PSME/SYAL-SYAL:DF0"
196 31321 5 0.0040 0.0080 0.0001 0.1700 0.0410 0.0001 "PSME/SYAL-SYAL:DF1"
197 31322 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/SYAL-SYAL:DF2"
198 31323 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-SYAL:DF3"
199 31324 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/SYAL-SYAL:DF"
200 31330 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL-SYAL:LP0"
201 31331 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL-SYAL:LP1"
```

```
202 31332 5 0.0090 0.0130 0.0001 0.1120 0.0710 0.0001 "PSME/SYAL-SYAL:LP2"
203 31333 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL-SYAL:LP3"
204 31334 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/SYAL-SYAL:LP"
205 31340 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/SYAL-SYAL:SF0"
206 31341 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/SYAL-SYAL:SF1"
207 31342 5 0.0090 0.0130 0.0001 0.1120 0.0710 0.0001 "PSME/SYAL-SYAL:SF2"
208 31350 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYAL-SYAL:WB0"
209 31370 1 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-SYAL:ASP0"
210 31371 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-SYAL:ASP1"
211 31372 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-SYAL:ASP2"
212 31373 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/SYAL-SYAL:ASP3"
213 31374 5 0.0060 0.0120 0.0001 0.1820 0.0570 0.0001 "PSME/SYAL-SYAL:ASP"
214 31384 5 0.0030 0.0100 0.0001 0.0030 0.0100 0.0001 "PSME/SYAL-SYAL:MF"
215 32020 1 0.0030 0.0260 0.0400 0.0510 0.0460 0.0490 "PSME/CARU:DF0"
216 32021 5 0.0030 0.0260 0.0490 0.1060 0.0460 0.0490 "PSME/CARU:DF1"
217 32022 5 0.0030 0.0310 0.1190 0.1180 0.0570 0.0560 "PSME/CARU:DF2"
218 32023 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CARU:DF3"
219 32024 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CARU:DF"
220 32030 1 0.0090 0.0750 0.1150 0.0160 0.0560 0.0940 "PSME/CARU:LP0"
221 32031 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU:LP1"
222 32032 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU:LP2"
223 32033 5 0.0180 0.0630 0.1680 0.0620 0.0640 0.1040 "PSME/CARU:LP3"
224 32034 5 0.0180 0.0630 0.1680 0.0620 0.0640 0.1040 "PSME/CARU:LP"
225 32040 1 0.0090 0.0750 0.1150 0.0160 0.0560 0.0940 "PSME/CARU:SF0"
226 32041 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU:SF1"
227 32042 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU:SF2"
228 32044 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/CARU:SF"
229 32054 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/CARU:WB"
230 32070 1 0.0030 0.0160 0.0001 0.0530 0.0190 0.0001 "PSME/CARU:ASP0"
231 32071 5 0.0030 0.0160 0.0001 0.0530 0.0190 0.0001 "PSME/CARU:ASP1"
232 32072 5 0.0030 0.0160 0.0001 0.0530 0.0190 0.0001 "PSME/CARU:ASP2"
233 32073 5 0.0030 0.0160 0.0001 0.0530 0.0190 0.0001 "PSME/CARU:ASP3"
234 32074 5 0.0040 0.0440 0.1030 0.1110 0.0630 0.0790 "PSME/CARU:ASP"
235 32130 1 0.0090 0.0750 0.1150 0.0160 0.0560 0.0940 "PSME/CARU-AGSP:LP0"
236 32131 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU-AGSP:LP1"
237 32132 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU-AGSP:LP2"
238 32231 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU-ARUV:LP1"
239 32320 1 0.0030 0.0260 0.0400 0.0150 0.0460 0.0490 "PSME/CARU-CARU:DF0"
240 32321 5 0.0030 0.0260 0.0490 0.1060 0.0460 0.0490 "PSME/CARU-CARU:DF1"
241 32322 5 0.0030 0.0310 0.1190 0.1180 0.0570 0.0560 "PSME/CARU-CARU:DF2"
242 32323 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CARU-CARU:DF3"
243 32324 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CARU-CARU:DF"
244 32330 1 0.0090 0.0750 0.1150 0.0160 0.0560 0.0940 "PSME/CARU-CARU:LP0"
245 32331 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU-CARU:LP1"
246 32332 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU-CARU:LP2"
247 32333 5 0.0180 0.0630 0.1680 0.0620 0.0640 0.1040 "PSME/CARU-CARU:LP3"
248 32334 5 0.0180 0.0630 0.1680 0.0620 0.0640 0.1040 "PSME/CARU-CARU:LP"
249 32340 1 0.0090 0.0750 0.1150 0.0160 0.0560 0.0940 "PSME/CARU-CARU:SF0"
250 32341 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CARU-CARU:SF1"
251 32342 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU-CARU:SF2"
252 32344 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/CARU-CARU:SF"
```

```
253 32370 1 0.0030 0.0760 0.0660 0.0150 0.0460 0.1120 "PSME/CARU-CARU:ASP0"
254 32371 5 0.0030 0.0760 0.0660 0.0150 0.0460 0.1120 "PSME/CARU-CARU:ASP1"
255 32372 5 0.0030 0.0760 0.0660 0.0150 0.0460 0.1120 "PSME/CARU-CARU:ASP2"
256 32373 5 0.0040 0.0440 0.1030 0.1110 0.0630 0.0790 "PSME/CARU-CARU:ASP3"
257 32374 5 0.0040 0.0440 0.1030 0.1110 0.0630 0.0790 "PSME/CARU-CARU:ASP"
258 32521 5 0.0030 0.0260 0.0490 0.1060 0.0460 0.0490 "PSME/CARU-PAMY:DF1"
259 32522 5 0.0030 0.0310 0.1190 0.1180 0.0570 0.0560 "PSME/CARU-PAMY:DF2"
260 32523 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CARU-PAMY:DF3"
261 32532 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CARU-PAMY:LP2"
262 33022 5 0.0030 0.0310 0.1190 0.1180 0.0570 0.0560 "PSME/CAGE:DF2"
263 33023 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CAGE:DF3"
264 33024 5 0.0040 0.0350 0.1160 0.1290 0.0690 0.0630 "PSME/CAGE:DF"
265 33031 5 0.0170 0.0750 0.1160 0.0550 0.0700 0.1310 "PSME/CAGE:LP1 (BGD)"
266 33032 5 0.0140 0.0520 0.1340 0.0880 0.0820 0.1440 "PSME/CAGE:LP2"
267 34020 1 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE:DF0"
268 34021 5 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE:DF1"
269 34022 5 0.0001 0.0550 0.1000 0.0001 0.0590 0.1280 "PSME/SPBE:DF2"
270 34023 5 0.0001 0.0600 0.1340 0.0001 0.0700 0.1440 "PSME/SPBE:DF3"
271 34024 5 0.0001 0.0600 0.1340 0.0001 0.0700 0.1440 "PSME/SPBE:DF"
272 34030 1 0.0001 0.1060 0.1270 0.0001 0.0600 0.1860 "PSME/SPBE:LP0"
273 34031 5 0.0001 0.1060 0.1290 0.0001 0.0720 0.2120 "PSME/SPBE:LP1"
274 34032 5 0.0001 0.0790 0.1470 0.0001 0.0810 0.2230 "PSME/SPBE:LP2"
275 34033 5 0.0001 0.0930 0.1810 0.0001 0.0660 0.1840 "PSME/SPBE:LP3"
276 34034 5 0.0001 0.0930 0.1810 0.0001 0.0660 0.1840 "PSME/SPBE:LP"
277 34040 1 0.0001 0.1060 0.1270 0.0001 0.0600 0.1860 "PSME/SPBE:SF0"
278 34041 5 0.0001 0.1060 0.1290 0.0001 0.0720 0.2120 "PSME/SPBE:SF1"
279 34042 5 0.0001 0.0790 0.1470 0.0001 0.0810 0.2230 "PSME/SPBE:SF2"
280 34052 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SPBE:WB2"
281 34070 1 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE:ASP0"
282 34071 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE:ASP1"
283 34072 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE:ASP2"
284 34073 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE:ASP3"
285 34074 5 0.0001 0.0700 0.1160 0.0001 0.0660 0.1600 "PSME/SPBE:ASP"
286 34120 1 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE-SPBE:DF0"
287 34121 5 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE-SPBE:DF1"
288 34122 5 0.0001 0.0550 0.0100 0.0001 0.0590 0.1280 "PSME/SPBE-SPBE:DF2"
289 34124 5 0.0001 0.0600 0.1340 0.0001 0.0700 0.1440 "PSME/SPBE-SPBE:DF"
290 34130 1 0.0001 0.1060 0.1270 0.0001 0.0600 0.1860 "PSME/SPBE-SPBE:LP0"
291 34131 5 0.0001 0.1060 0.1290 0.0001 0.0720 0.2120 "PSME/SPBE-SPBE:LP1"
292 34132 5 0.0001 0.0790 0.1470 0.0001 0.0810 0.2230 "PSME/SPBE-SPBE:LP2"
293 34133 5 0.0001 0.0930 0.1810 0.0001 0.0660 0.1840 "PSME/SPBE-SPBE:LP3"
294 34134 5 0.0001 0.0930 0.1810 0.0001 0.0660 0.1840 "PSME/SPBE-SPBE:LP"
295 34170 1 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE-SPBE:ASP0"
296 34171 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE-SPBE:ASP1"
297 34172 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE-SPBE:ASP2"
298 34173 5 0.0001 0.0100 0.0140 0.0001 0.0040 0.0260 "PSME/SPBE-SPBE:ASP3"
299 34174 5 0.0001 0.0700 0.1160 0.0001 0.0600 0.1600 "PSME/SPBE-SPBE:ASP"
300 34272 5 0.0001 0.0700 0.0500 0.0001 0.0700 0.0500 "342 is not a valid h.t. DUPPE
301 34320 1 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE-CARU:DF0"
302 34321 5 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "PSME/SPBE-CARU:DF1"
303 34322 5 0.0001 0.0550 0.1000 0.0001 0.0590 0.1280 "PSME/SPBE-CARU:DF2"
```

```
304  34323  5  0.0001  0.0600  0.1340  0.0001  0.0700  0.1440  "PSME/SPBE-CARU:DF3"
305  34324  5  0.0001  0.0600  0.1340  0.0001  0.0700  0.1440  "PSME/SPBE-CARU:DF"
306  34330  1  0.0001  0.1060  0.1270  0.0001  0.0600  0.0860  "PSME/SPBE-CARU:LP0"
307  34331  5  0.0001  0.1060  0.1290  0.0001  0.0720  0.2120  "PSME/SPBE-CARU:LP1"
308  34332  5  0.0001  0.0790  0.1470  0.0001  0.0810  0.2230  "PSME/SPBE-CARU:LP2"
309  34333  5  0.0001  0.0930  0.1810  0.0001  0.0660  0.1840  "PSME/SPBE-CARU:LP3"
310  34334  5  0.0001  0.0930  0.1810  0.0001  0.0660  0.1840  "PSME/SPBE-CARU:LP"
311  34340  1  0.0001  0.1060  0.1270  0.0001  0.0600  0.1860  "PSME/SPBE-CARU:SF0"
312  34341  5  0.0001  0.1060  0.1290  0.0001  0.0720  0.2120  "PSME/SPBE-CARU:SF1"
313  34342  5  0.0001  0.0790  0.1470  0.0001  0.0810  0.2230  "PSME/SPBE-CARU:SF2"
314  34370  1  0.0020  0.0570  0.1100  0.0560  0.0640  0.1200  "PSME/SPBE-CARU:ASP0"
315  34371  5  0.0020  0.0570  0.1100  0.0560  0.0640  0.1200  "PSME/SPBE-CARU:ASP1"
316  34372  5  0.0020  0.0570  0.1100  0.0560  0.0640  0.1200  "PSME/SPBE-CARU:ASP2"
317  34373  5  0.0020  0.0570  0.1100  0.0560  0.0640  0.1200  "PSME/SPBE-CARU:ASP3"
318  34374  5  0.0020  0.0570  0.1100  0.0001  0.0660  0.1600  "PSME/SPBE-CARU:ASP"
319  36013  5  0.0830  0.0070  0.0001  0.0900  0.0080  0.0001  "PSME/JUCO:LI3"
320  36020  1  0.0690  0.0060  0.0001  0.0210  0.0050  0.0001  "PSME/JUCO:DF0"
321  36021  5  0.0690  0.0060  0.0001  0.0670  0.0050  0.0001  "PSME/JUCO:DF1"
322  36022  5  0.0760  0.0060  0.0001  0.0780  0.0070  0.0001  "PSME/JUCO:DF2"
323  36023  5  0.0830  0.0070  0.0001  0.0900  0.0080  0.0001  "PSME/JUCO:DF3"
324  36024  5  0.0830  0.0070  0.0001  0.0900  0.0080  0.0001  "PSME/JUCO:DF"
325  36030  1  0.1130  0.0120  0.0001  0.0001  0.0070  0.0001  "PSME/JUCO:LP0"
326  36031  5  0.1590  0.0120  0.0001  0.0150  0.0080  0.0001  "PSME/JUCO:LP1"
327  36032  5  0.1440  0.0090  0.0001  0.0470  0.0090  0.0001  "PSME/JUCO:LP2"
328  36033  5  0.1670  0.0110  0.0001  0.0220  0.0080  0.0001  "PSME/JUCO:LP3"
329  36034  5  0.1670  0.0110  0.0001  0.0220  0.0080  0.0001  "PSME/JUCO:LP"
330  36040  1  0.1130  0.0120  0.0001  0.0001  0.0070  0.0001  "PSME/JUCO:SF0"
331  36041  5  0.1590  0.0120  0.0001  0.0150  0.0080  0.0001  "PSME/JUCO:SF1"
332  36042  5  0.1440  0.0090  0.0001  0.0470  0.0090  0.0001  "PSME/JUCO:SF2"
333  36050  1  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PSME/JUCO:WB0"
334  36051  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PSME/JUCO:WB1"
335  36052  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PSME/JUCO:WB2"
336  36053  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PSME/JUCO:WB3"
337  36054  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PSME/JUCO:WB "
338  36064  5  0.0830  0.0070  0.0001  0.0090  0.0080  0.0001  "PSME/JUCO:OW"
339  36070  1  0.0230  0.0020  0.0001  0.0130  0.0001  0.0001  "PSME/JUCO:ASP0"
340  36071  5  0.0230  0.0020  0.0001  0.0130  0.0001  0.0001  "PSME/JUCO:ASP1"
341  36072  5  0.0230  0.0020  0.0001  0.0130  0.0001  0.0001  "PSME/JUCO:ASP2"
342  36073  5  0.0230  0.0020  0.0001  0.0130  0.0001  0.0001  "PSME/JUCO:ASP3"
343  36074  5  0.0970  0.0080  0.0001  0.0710  0.0080  0.0001  "PSME/JUCO:ASP"
344  36082  5  0.0760  0.0060  0.0001  0.0780  0.0070  0.0001  "PSME/JUCO:MF2"
345  37020  1  0.0690  0.0060  0.0001  0.0210  0.0050  0.0001  "PSME/ARCO:DF0"
346  37021  5  0.0690  0.0060  0.0001  0.0670  0.0050  0.0001  "PSME/ARCO:DF1"
347  37022  5  0.0760  0.0060  0.0001  0.0780  0.0070  0.0001  "PSME/ARCO:DF2"
348  37023  5  0.0830  0.0060  0.0001  0.0090  0.0080  0.0001  "PSME/ARCO:DF3"
349  37024  5  0.0830  0.0070  0.0001  0.0090  0.0080  0.0001  "PSME/ARCO:DF"
350  37030  1  0.1130  0.0120  0.0001  0.0001  0.0070  0.0001  "PSME/ARCO:LP0"
351  37031  5  0.1590  0.0120  0.0001  0.0150  0.0080  0.0001  "PSME/ARCO:LP1"
352  37032  5  0.1440  0.0090  0.0001  0.0470  0.0090  0.0001  "PSME/ARCO:LP2"
353  37033  5  0.1670  0.0110  0.0001  0.0220  0.0080  0.0001  "PSME/ARCO:LP3"
354  37034  5  0.1670  0.0110  0.0001  0.0220  0.0080  0.0001  "PSME/ARCO:LP"
```

```
355 37040 1 0.1130 0.0120 0.0001 0.0001 0.0070 0.0001 "PSME/ARCO:SF0"
356 37041 5 0.1590 0.0120 0.0001 0.0150 0.0080 0.0001 "PSME/ARCO:SF1"
357 37042 5 0.1440 0.0090 0.0001 0.0470 0.0090 0.0001 "PSME/ARCO:SF2"
358 37070 1 0.0001 0.0001 0.0001 0.0001 0.1120 0.0001 "PSME/ARCO:ASP0"
359 37071 5 0.0001 0.0001 0.0001 0.0001 0.1120 0.0001 "PSME/ARCO:ASP1"
360 37072 5 0.0001 0.0001 0.0001 0.0001 0.1120 0.0001 "PSME/ARCO:ASP2"
361 37073 5 0.0001 0.0001 0.0001 0.0001 0.1120 0.0001 "PSME/ARCO:ASP3"
362 37074 5 0.0001 0.0001 0.0001 0.0710 0.0080 0.0001 "PSME/ARCO:ASP"
363 37122 5 0.0760 0.0060 0.0001 0.0780 0.0070 0.0001 "PSME/ARCO-ARCO:DF2"
364 37123 5 0.0830 0.0060 0.0001 0.0090 0.0080 0.0001 "PSME/ARCO-ARCO:DF3"
365 37272 5 0.0230 0.0020 0.0001 0.0130 0.0001 0.0001 "PSME/ARCO-ASMI:ASP2"
366 37513 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/OSCH:LI3"
367 37520 1 0.0340 0.0360 0.0001 0.0160 0.0340 0.0001 "PSME/OSCH:DF0"
368 37522 5 0.0570 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/OSCH:DF2"
369 37523 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/OSCH:DF3"
370 37524 5 0.0650 0.0043 0.0001 0.0700 0.0500 0.0001 "PSME/OSCH:DF"
371 37530 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/OSCH:LP0"
372 37531 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/OSCH:LP1 (TNF)"
373 37532 5 0.1120 0.0570 0.0001 0.0370 0.0580 0.0001 "PSME/OSCH:LP2"
374 37533 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/OSCH:LP3"
375 37570 1 0.0340 0.0360 0.0001 0.0160 0.0340 0.0001 "PSME/OSCH:ASP0 (TNF)"
376 37572 5 0.3990 0.0100 0.0140 0.1820 0.0570 0.0001 "PSME/OSCH:ASP2"
377 37573 5 0.3990 0.0100 0.0140 0.1820 0.0570 0.0001 "PSME/OSCH:ASP3"
378 37582 5 0.0590 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/OSCH:MF2"
379 38020 1 0.0300 0.0300 0.0001 0.0320 0.0720 0.0001 "PSME/SYOR:DF0"
380 38021 5 0.0480 0.0300 0.0001 0.0530 0.0720 0.0001 "PSME/SYOR:DF1"
381 38022 5 0.0560 0.0360 0.0001 0.0620 0.0890 0.0001 "PSME/SYOR:DF2"
382 38023 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001 "PSME/SYOR:DF3"
383 38024 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001 "PSME/SYOR:DF"
384 38030 1 0.0001 0.0001 0.0001 0.0320 0.0720 0.0001 "PSME/SYOR:LP0"
385 38031 5 0.0001 0.0001 0.0001 0.0530 0.0720 0.0001 "PSME/SYOR:LP1"
386 38032 5 0.0001 0.0001 0.0001 0.0620 0.0890 0.0001 "PSME/SYOR:LP2"
387 38033 5 0.0001 0.0001 0.0001 0.0650 0.1060 0.0001 "PSME/SYOR:LP3"
388 38034 5 0.0001 0.0001 0.0001 0.0650 0.1060 0.0001 "PSME/SYOR:LP"
389 38040 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYOR:SF0 "
390 38041 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYOR:SF1"
391 38042 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PSME/SYOR:SF2"
392 38070 1 0.0230 0.0100 0.0001 0.0130 0.0320 0.0001 "PSME/SYOR:ASP0"
393 38071 5 0.0230 0.0100 0.0001 0.0130 0.0320 0.0001 "PSME/SYOR:ASP1"
394 38072 5 0.0230 0.0100 0.0001 0.0130 0.0320 0.0001 "PSME/SYOR:ASP2"
395 38073 5 0.0230 0.0100 0.0001 0.0130 0.0320 0.0001 "PSME/SYOR:ASP3"
396 38074 5 0.0510 0.0420 0.0001 0.0510 0.0420 0.0001 "PSME/SYOR:ASP"
397 38524 5 0.0590 0.0420 0.0001 0.0650 0.1060 0.0001 "PSME/CELE:DF"
398 39020 1 0.0040 0.0080 0.0001 0.0530 0.0410 0.0001 "PSME/ACGL:DF0 (BGD)"
399 39021 5 0.0040 0.0090 0.0001 0.0040 0.0090 0.0001 "PSME/ACGL:DF1 "
400 39022 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/ACGL:DF2"
401 39023 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/ACGL:DF3"
402 39024 5 0.0020 0.0120 0.0001 0.2300 0.0610 0.0001 "PSME/ACGL:DF"
403 39030 1 0.0070 0.0180 0.0001 0.0001 0.0520 0.0001 "PSME/ACGL:LP0"
404 39031 5 0.0100 0.0180 0.0001 0.0390 0.0630 0.0001 "PSME/ACGL:LP1"
405 39032 5 0.0090 0.0130 0.0001 0.1220 0.0710 0.0001 "PSME/ACGL:LP2"
```

```
406 39033 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/ACGL:LP3"
407 39034 5 0.0100 0.0160 0.0001 0.0550 0.0580 0.0001 "PSME/ACGL:LP"
408 39070 1 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/ACGL:ASP0"
409 39072 5 0.0010 0.0020 0.0001 0.2540 0.0240 0.0001 "PSME/ACGL:ASP2"
410 39082 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/ACGL:MF2"
411 39122 5 0.0040 0.0090 0.0001 0.2000 0.0510 0.0001 "PSME/ACGL-PAMY:DF2"
412 39123 5 0.0050 0.0100 0.0001 0.2300 0.0610 0.0001 "PSME/ACGL-PAMY:DF3(BGD)"
413 39124 5 0.0020 0.0120 0.0001 0.2300 0.0610 0.0001 "PSME/ACGL-PAMY:DF (BGD)"
414 39520 1 0.0540 0.0360 0.0001 0.0160 0.0340 0.0001 "PSME/BERE:DF0"
415 39521 5 0.0540 0.0360 0.0001 0.0520 0.0340 0.0001 "PSME/BERE:DF1"
416 39522 5 0.0590 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/BERE:DF2"
417 39523 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE:DF3"
418 39524 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE:DF"
419 39530 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/BERE:LP0"
420 39531 5 0.0250 0.0760 0.0001 0.0120 0.0520 0.0001 "PSME/BERE:LP1"
421 39532 5 0.1120 0.0570 0.0001 0.0370 0.0580 0.0001 "PSME/BERE:LP2"
422 39533 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/BERE:LP3"
423 39534 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/BERE:LP"
424 39540 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/BERE:SF0"
425 39541 5 0.0250 0.0760 0.0001 0.0120 0.0520 0.0001 "PSME/BERE:SF1"
426 39542 5 0.1120 0.0570 0.0001 0.0370 0.0580 0.0001 "PSME/BERE:SF2"
427 39570 1 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE:ASP0"
428 39571 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE:ASP1"
429 39572 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE:ASP2"
430 39573 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE:ASP3"
431 39574 5 0.0760 0.0500 0.0001 0.0550 0.0470 0.0001 "PSME/BERE:ASP"
432 39622 5 0.0590 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/BERE-BERE:DF2"
433 39720 1 0.0540 0.0360 0.0001 0.0160 0.0340 0.0001 "PSME/BERE-SYOR:DF0 (TNF)"
434 39722 5 0.0590 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/BERE-SYOR:DF2"
435 39723 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE-SYOR:DF3"
436 39724 5 0.0620 0.0420 0.0010 0.0700 0.0500 0.0010 "PSME/BERE-SYOR:DF"
437 39730 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/BERE-SYOR:LP0"
438 39733 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/BERE-SYOR:LP3"
439 39741 5 0.0250 0.0760 0.0001 0.0120 0.0520 0.0001 "PSME/BERE-SYOR:SF1"
440 39772 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE-SYOR:ASP2"
441 39773 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE-SYOR:ASP3"
442 39820 1 0.0540 0.0360 0.0001 0.0160 0.0340 0.0001 "PSME/BERE-CAGE:DF0 (TNF)"
443 39821 5 0.0540 0.0360 0.0001 0.0520 0.0340 0.0001 "PSME/BERE-CAGE:DF1"
444 39822 5 0.0590 0.0390 0.0001 0.0610 0.0420 0.0001 "PSME/BERE-CAGE:DF2"
445 39823 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE-CAGE:DF3"
446 39824 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE-CAGE:DF"
447 39830 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "PSME/BERE-CAGE:LP0"
448 39831 5 0.0250 0.0760 0.0001 0.0120 0.0520 0.0001 "PSME/BERE-CAGE:LP1"
449 39832 5 0.1120 0.0570 0.0001 0.0370 0.0580 0.0001 "PSME/BERE-CAGE:LP2"
450 39833 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/BERE-CAGE:LP3"
451 39834 5 0.1310 0.0670 0.0001 0.0170 0.0480 0.0001 "PSME/BERE-CAGE:LP"
452 39871 5 0.3990 0.0100 0.0140 0.2200 0.0040 0.0260 "PSME/BERE-CAGE:ASP1"
453 39922 5 0.0590 0.0590 0.0001 0.0610 0.0420 0.0001 "PSME/BERE-JUCO:DF2"
454 39923 5 0.0650 0.0430 0.0001 0.0700 0.0500 0.0001 "PSME/BERE-JUCO:DF3"
455 39932 5 0.1120 0.0570 0.0001 0.0370 0.0580 0.0001 "PSME/BERE-JUCO:LP2"
456 41020 1 0.0650 0.1270 0.0001 0.0810 0.1630 0.0001 "PIEN/EQAR:DF0"
```

```
457 41021 5 0.0650 0.1270 0.0001 0.5770 0.1630 0.0001 "PIEN/EQAR:DF1"
458 41022 5 0.0700 0.1500 0.0001 0.6390 0.2040 0.0001 "PIEN/EQAR:DF2"
459 41023 5 0.0790 0.1730 0.0001 0.7010 0.2440 0.0001 "PIEN/EQAR:DF3"
460 41024 5 0.0790 0.1730 0.0001 0.7010 0.2440 0.0001 "PIEN/EQAR:DF"
461 41030 1 0.1820 0.3660 0.0001 0.0860 0.1980 0.0001 "PIEN/EQAR:LP0"
462 41031 5 0.3500 0.3660 0.0001 0.3000 0.2500 0.0001 "PIEN/EQAR:LP1"
463 41032 5 0.2940 0.2540 0.0001 0.4770 0.2910 0.0001 "PIEN/EQAR:LP2"
464 41033 5 0.3790 0.3100 0.0001 0.3340 0.2270 0.0001 "PIEN/EQAR:LP3"
465 41034 5 0.5790 0.3100 0.0001 0.3340 0.2270 0.0001 "PIEN/EQAR:LP"
466 41040 1 0.1820 0.3660 0.0001 0.0860 0.1980 0.0001 "PIEN/EQAR:SF0"
467 41041 5 0.3500 0.3660 0.0001 0.3000 0.2500 0.0001 "PIEN/EQAR:SF1"
468 41042 5 0.2940 0.2540 0.0001 0.4770 0.2910 0.0001 "PIEN/EQAR:SF2"
469 41044 5 0.3850 0.3890 0.0001 0.4150 0.3000 0.0001 "PIEN/EQAR:SF"
470 41070 1 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/EQAR:ASP0"
471 41071 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/EQAR:ASP1"
472 41072 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/EQAR:ASP2"
473 41073 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/EQAR:ASP3"
474 41074 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/EQAR:ASP"
475 41080 1 0.0650 0.1270 0.0001 0.5770 0.1630 0.0001 "PIEN/EQAR:MF0 (CDB)"
476 41081 5 0.0650 0.1270 0.0001 0.5770 0.1630 0.0001 "PIEN/EQAR:MF1"
477 41090 5 0.3990 0.0100 0.0140 0.0550 0.0470 0.0001 "COTTONWOOD:CTWD(RWM)"
478 41091 5 0.3990 0.0100 0.0140 0.0550 0.0470 0.0001 "COTTONWOOD:CTWD(RWM)"
479 41092 5 0.3990 0.0100 0.0140 0.0550 0.0470 0.0001 "COTTONWOOD:CTWD(RWM)"
480 41093 5 0.3990 0.0100 0.0140 0.0550 0.0470 0.0001 "COTTONWOOD:CTWD(RWM)"
481 41533 5 0.1900 0.1550 0.0001 0.1670 0.1140 0.0001 "PIEN/CALE:LP3"
482 41540 1 0.1820 0.3660 0.0001 0.1820 0.3660 0.0001 "PIEN/CALE:SF0 "
483 41541 5 0.1750 0.1830 0.0001 0.1500 0.1250 0.0001 "PIEN/CALE:SF1"
484 41544 5 0.1920 0.1940 0.0001 0.2080 0.1500 0.0001 "PIEN/CALE:SF"
485 42141 5 0.0500 0.1940 0.0001 0.1500 0.1250 0.0001 "PIEN/CLUN-CLUN:SF1"
486 43022 5 0.0040 0.0090 0.0001 0.0001 0.1410 0.0001 "PIEN/PHMA:DF2"
487 43023 5 0.0050 0.0100 0.0001 0.0001 0.1690 0.0001 "PIEN/PHMA:DF3"
488 44020 1 0.0110 0.0420 0.0001 0.0090 0.0530 0.0001 "PIEN/GATR:DF0"
489 44021 5 0.0110 0.0420 0.0001 0.0650 0.0530 0.0001 "PIEN/GATR:DF1"
490 44022 5 0.0120 0.0490 0.0001 0.0720 0.0660 0.0001 "PIEN/GATR:DF2"
491 44023 5 0.0130 0.0560 0.0001 0.0790 0.0790 0.0001 "PIEN/GATR:DF3"
492 44024 5 0.0130 0.0560 0.0001 0.0790 0.0790 0.0001 "PIEN/GATR:DF"
493 44030 1 0.0300 0.1200 0.0001 0.0100 0.0640 0.0001 "PIEN/GATR:LP0"
494 44031 5 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "PIEN/GATR:LP1"
495 44032 5 0.0490 0.0830 0.0001 0.0540 0.0940 0.0001 "PIEN/GATR:LP2"
496 44033 5 0.0630 0.1010 0.0001 0.0380 0.0730 0.0001 "PIEN/GATR:LP3"
497 44034 5 0.0630 0.1010 0.0001 0.0380 0.0730 0.0001 "PIEN/GATR:LP"
498 44040 1 0.0300 0.1200 0.0001 0.0100 0.0640 0.0001 "PIEN/GATR:SF0"
499 44041 5 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "PIEN/GATR:SF1"
500 44042 5 0.0490 0.0830 0.0001 0.0540 0.0940 0.0001 "PIEN/GATR:SF2"
501 44044 5 0.0640 0.1270 0.0001 0.0470 0.0970 0.0001 "PIEN/GATR:SF"
502 44063 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PIEN/GATR:KR (BGD)"
503 44070 1 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/GATR:ASP0"
504 44071 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/GATR:ASP1"
505 44072 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/GATR:ASP2"
506 44073 5 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "PIEN/GATR:ASP3"
507 44074 5 0.0940 0.2160 0.0001 0.0680 0.0720 0.0001 "PIEN/GATR:ASP"
```

```
508  44090  5  0.3990  0.0100  0.0140  0.0550  0.0470  0.0001  "COTTONWOOD:CTWD(RWM)"
509  44091  5  0.3990  0.0100  0.0140  0.0550  0.0470  0.0001  "COTTONWOOD:CTWD(RWM)"
510  44092  5  0.3990  0.0100  0.0140  0.0550  0.0470  0.0001  "COTTONWOOD:CTWD(RWM)"
511  44093  5  0.3990  0.0100  0.0140  0.0550  0.0470  0.0001  "COTTONWOOD:CTWD(RWM)"
512  46044  5  0.0640  0.1270  0.0001  0.0470  0.0970  0.0001  "PIEN/SEST:SF"
513  46123  5  0.0130  0.0560  0.0001  0.0790  0.0790  0.0001  "PIEN/SEST-PSME:DF3"
514  46124  5  0.0130  0.0560  0.0001  0.0790  0.0790  0.0001  "PIEN/SEST-PSME:DF"
515  47013  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/LIBO:LI3"
516  47020  1  0.0090  0.0680  0.0001  0.0260  0.0860  0.1560  "PIEN/LIBO:DF0"
517  47021  5  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "PIEN/LIBO:DF1"
518  47022  5  0.0100  0.0800  0.0001  0.2050  0.1080  0.1790  "PIEN/LIBO:DF2"
519  47023  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/LIBO:DF3"
520  47024  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/LIBO:DF"
521  47030  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "PIEN/LIBO:LP0"
522  47031  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "PIEN/LIBO:LP1"
523  47032  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "PIEN/LIBO:LP2"
524  47033  5  0.0550  0.1650  0.0001  0.1070  0.1200  0.3300  "PIEN/LIBO:LP3"
525  47034  5  0.0550  0.1650  0.0001  0.1070  0.1200  0.3300  "PIEN/LIBO:LP"
526  47044  5  0.0550  0.2060  0.0001  0.1330  0.1590  0.5000  "PIEN/LIBO:SF"
527  47070  1  0.1300  0.1150  0.0001  0.1930  0.1180  0.2520  "PIEN/LIBO:ASP0 (BGD)"
528  47072  5  0.0130  0.1150  0.0001  0.1930  0.1180  0.2520  "PIEN/LIBO:ASP2"
529  47073  5  0.0130  0.1150  0.0001  0.1930  0.1180  0.2520  "PIEN/LIBO:ASP3"
530  47080  1  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "PIEN/LIBO:MF0 (CDB)"
531  47081  5  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "PIEN/LIBO:MF1"
532  47523  5  0.0830  0.0070  0.0001  0.0900  0.0080  0.0001  "PIEN/JUCO:DF3"
533  47524  5  0.0830  0.0070  0.0001  0.0900  0.0080  0.0001  "PIEN/JUCO:DF"
534  47531  5  0.0001  0.1180  0.3000  0.0001  0.0810  0.3380  "PIEN/JUCO:LP1"
535  47532  5  0.0001  0.0820  0.3450  0.0001  0.0940  0.3720  "PIEN/JUCO:LP2"
536  47533  5  0.0001  0.1000  0.4310  0.0001  0.0730  0.2680  "PIEN/JUCO:LP3"
537  47540  1  0.0001  0.1180  0.2970  0.0001  0.0640  0.2420  "PIEN/JUCO:SF0"
538  47541  5  0.0001  0.1180  0.3000  0.0001  0.0810  0.3380  "PIEN/JUCO:SF1 (BGD)"
539  47544  5  0.0001  0.1250  0.4690  0.0001  0.0970  0.4050  "PIEN/JUCO:SF"
540  47554  5  0.0001  0.1370  0.5350  0.0001  0.0790  0.5950  "PIEN/JUCO:WB"
541  47563  5  0.0001  0.0890  0.2480  0.0001  0.0140  0.2010  "PIEN/JUCO:KR"
542  48022  5  0.0100  0.0800  0.0001  0.2050  0.1080  0.1790  "PIEN/SMST:DF2"
543  48023  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/SMST:DF3"
544  48024  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/SMST:DF"
545  48032  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "PIEN/SMST:LP2"
546  48033  5  0.0550  0.0650  0.0001  0.1070  0.1200  0.3300  "PIEN/SMST:LP3"
547  48044  5  0.0640  0.1270  0.0001  0.0470  0.0970  0.0001  "PIEN/SMST:SF"
548  48084  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "PIEN/SMST:MF"
549  48530  1  0.0060  0.2450  0.3340  0.0150  0.1600  0.2790  "PIEN/VASC:LP0"
550  48532  5  0.0100  0.1700  0.3880  0.0820  0.2360  0.4290  "PIEN/VASC:LP2"
551  48533  5  0.0130  0.2070  0.4850  0.0570  0.1840  0.3090  "PIEN/VASC:LP3"
552  48540  1  0.0060  0.2450  0.3340  0.0150  0.1600  0.2790  "PIEN/VASC:SF0"
553  48541  5  0.0120  0.2450  0.3380  0.0520  0.2030  0.3900  "PIEN/VASC:SF1"
554  48544  5  0.0130  0.1600  0.5280  0.0710  0.2430  0.4680  "PIEN/VASC:SF"
555  48552  5  0.0001  0.2540  0.8590  0.0001  0.2970  0.6840  "PIEN/VASC:WB2"
556  48553  5  0.0001  0.2510  0.9760  0.0001  0.2860  0.9920  "PIEN/VASC:WB3"
557  48554  5  0.0001  0.2510  0.9760  0.0001  0.2860  0.9920  "PIEN/VASC:WB"
558  49030  1  0.1820  0.3660  0.0001  0.0860  0.1980  0.0001  "PIEN/CADI:LP0 (BGD)"
```

```
559 49032 5 0.2940 0.2540 0.0001 0.4770 0.2910 0.0001 "PIEN/CADI:LP2 (BGD)"
560 49033 5 0.3790 0.3100 0.0001 0.3340 0.2270 0.0001 "PIEN/CADI:LP3"
561 49044 5 0.3850 0.3890 0.0001 0.4150 0.3000 0.0001 "PIEN/CADI:SF"
562 49322 5 0.0200 0.0500 0.0001 0.1210 0.0670 0.0001 "PIEN/HYRE:DF2"
563 49323 5 0.0020 0.0570 0.0001 0.1320 0.0810 0.0001 "PIEN/HYRE:DF3"
564 49344 5 0.1090 0.1280 0.0001 0.0780 0.0990 0.0001 "PIEN/HYRE:SF"
565 49522 5 0.0200 0.0500 0.0001 0.1210 0.0670 0.0001 "PIEN/ARCO:DF2"
566 49523 5 0.0220 0.0570 0.0001 0.1320 0.0810 0.0001 "PIEN/ARCO:DF3"
567 49530 1 0.0510 0.1210 0.0001 0.0160 0.0650 0.0001 "PIEN/ARCO:LP0"
568 49531 5 0.0990 0.1210 0.0001 0.0570 0.0820 0.0001 "PIEN/ARCO:LP1"
569 49532 5 0.0830 0.0840 0.0001 0.0900 0.0960 0.0001 "PIEN/ARCO:LP2"
570 49533 5 0.1070 0.1020 0.0001 0.0630 0.0750 0.0001 "PIEN/ARCO:LP3"
571 49540 1 0.0510 0.1210 0.0001 0.0160 0.0650 0.0001 "PIEN/ARCO:SF0"
572 49544 5 0.1090 0.1280 0.0001 0.0780 0.0990 0.0001 "PIEN/ARCO:SF"
573 49553 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "PIEN/ARCO:WB3"
574 49573 5 0.0260 0.0710 0.0001 0.1130 0.0740 0.0001 "PIEN/ARCO:ASP3"
575 49734 5 0.0001 0.0170 0.2420 0.0001 0.0001 0.0001 "PIEN/RIMO:LP"
576 49744 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "PIEN/RIMO:SF"
577 49753 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "PIEN/RIMO:WB3"
578 60120 1 0.0110 0.0420 0.0001 0.0090 0.0530 0.0001 "ABLA/ACRU:DF0 (CDB)"
579 60122 5 0.0120 0.0490 0.0001 0.0720 0.0660 0.0001 "ABLA/ACRU:DF2"
580 60123 5 0.0130 0.0560 0.0001 0.0790 0.0790 0.0001 "ABLA/ACRU:DF3"
581 60130 1 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "ABLA/ACRU:LP0 (CDB)"
582 60131 5 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "ABLA/ACRU:LP1"
583 60132 5 0.0490 0.0830 0.0001 0.0540 0.0940 0.0001 "ABLA/ACRU:LP2"
584 60133 5 0.0630 0.1010 0.0001 0.0380 0.0730 0.0001 "ABLA/ACRU:LP3"
585 60140 1 0.0300 0.1200 0.0001 0.0100 0.0640 0.0001 "ABLA/ACRU:SF0"
586 60141 5 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "ABLA/ACRU:SF1"
587 60144 5 0.0640 0.1270 0.0001 0.0470 0.0970 0.0001 "ABLA/ACRU:SF"
588 60150 1 0.0001 0.0890 0.2380 0.0001 0.0890 0.2380 "ABLA/ACRU:WB0"
589 60153 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/ACRU:WB3"
590 60170 1 0.0940 0.2160 0.0001 0.6010 0.2240 0.0001 "ABLA/ACRU:ASP0"
591 60181 5 0.0110 0.0420 0.0001 0.0650 0.0530 0.0001 "ABLA/ACRU:MF1"
592 60182 5 0.0120 0.0490 0.0001 0.0720 0.0660 0.0001 "ABLA/ACRU:MF2"
593 60332 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/PHMA:LP2"
594 60333 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/PHMA:LP3"
595 60340 1 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/PHMA:SF0"
596 60341 5 0.0001 0.0660 0.0001 0.0001 0.1730 0.0001 "ABLA/PHMA:SF1"
597 60344 5 0.0001 0.0700 0.0001 0.0001 0.2070 0.0001 "ABLA/PHMA:SF"
598 60353 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/PHMA:WB3"
599 60720 1 0.0001 0.0230 0.0001 0.0001 0.1120 0.0001 "ABLA/SYAL:DF0"
600 60721 5 0.0001 0.0230 0.0001 0.0001 0.1120 0.0001 "ABLA/SYAL:DF1"
601 60722 5 0.0001 0.0270 0.0001 0.0001 0.1410 0.0001 "ABLA/SYAL:DF2"
602 60723 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/SYAL:DF3"
603 60724 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/SYAL:DF"
604 60730 1 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/SYAL:LP0"
605 60731 5 0.0001 0.0660 0.0001 0.0001 0.1730 0.0001 "ABLA/SYAL:LP1"
606 60732 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/SYAL:LP2"
607 60733 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/SYAL:LP3"
608 60734 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/SYAL:LP"
609 60740 1 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/SYAL:SF0"
```

```
610 60741 5 0.0001 0.0660 0.0001 0.0001 0.1730 0.0001 "ABLA/SYAL:SF1"
611 60742 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/SYAL:SF2"
612 60744 5 0.0001 0.0700 0.0001 0.0001 0.2070 0.0001 "ABLA/SYAL:SF"
613 60753 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/SYAL:WB3"
614 60770 1 0.0001 0.0100 0.0001 0.0001 0.1260 0.0001 "ABLA/SYAL:ASP0"
615 60771 5 0.0001 0.0100 0.0001 0.0001 0.1260 0.0001 "ABLA/SYAL:ASP1"
616 60772 5 0.0001 0.0100 0.0001 0.0001 0.1260 0.0001 "ABLA/SYAL:ASP2"
617 60773 5 0.0001 0.0390 0.0001 0.0001 0.1550 0.0001 "ABLA/SYAL:ASP3"
618 60774 5 0.0001 0.0390 0.0001 0.0001 0.1550 0.0001 "ABLA/SYAL:ASP"
619 60781 5 0.0001 0.0230 0.0001 0.0001 0.1120 0.0001 "ABLA/SYAL:MF1"
620 60782 5 0.0001 0.0270 0.0001 0.0001 0.1410 0.0001 "ABLA/SYAL:MF2"
621 60784 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/SYAL:MF"
622 60920 1 0.0040 0.0360 0.0520 0.0450 0.0750 0.0580 "ABLA/THOC:DF0"
623 60921 5 0.0040 0.0360 0.0520 0.3190 0.0750 0.0580 "ABLA/THOC:DF1"
624 60922 5 0.0040 0.0420 0.1540 0.3540 0.0940 0.0660 "ABLA/THOC:DF2"
625 60923 5 0.0050 0.0480 0.1500 0.3880 0.1120 0.0750 "ABLA/THOC:DF3"
626 60924 5 0.0050 0.0480 0.1500 0.3880 0.1120 0.0750 "ABLA/THOC:DF"
627 60930 1 0.0120 0.1020 0.1490 0.0480 0.0910 0.1100 "ABLA/THOC:LP0"
628 60931 5 0.0230 0.1020 0.1500 0.1660 0.1150 0.1550 "ABLA/THOC:LP1"
629 60932 5 0.0190 0.0710 0.1730 0.2640 0.1340 0.1700 "ABLA/THOC:LP2"
630 60933 5 0.0240 0.0870 0.2160 0.1850 0.1040 0.1220 "ABLA/THOC:LP3"
631 60934 5 0.0240 0.0870 0.2160 0.1850 0.1040 0.1220 "ABLA/THOC:LP"
632 60940 1 0.0120 0.1020 0.1490 0.0480 0.0910 0.1100 "ABLA/THOC:SF0"
633 60941 5 0.0230 0.1020 0.1500 0.1660 0.1150 0.1550 "ABLA/THOC:SF1"
634 60942 5 0.0190 0.0710 0.1730 0.2640 0.1340 0.1700 "ABLA/THOC:SF2"
635 60944 5 0.0250 0.1090 0.2350 0.2300 0.1380 0.1850 "ABLA/THOC:SF"
636 60950 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/THOC:WB0"
637 60951 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/THOC:WB1"
638 60952 5 0.0010 0.1100 0.2000 0.1500 0.1120 0.2720 "ABLA/THOC:WB2"
639 60953 5 0.0010 0.1100 0.2000 0.1500 0.1120 0.2720 "ABLA/THOC:WB3"
640 60954 5 0.0010 0.1100 0.2000 0.1500 0.1120 0.2720 "ABLA/THOC:WB"
641 60963 5 0.0001 0.0001 0.1000 0.0001 0.0001 0.1000 "ABLA/THOC:KR"
642 60970 1 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/THOC:ASP0"
643 60971 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/THOC:ASP1"
644 60972 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/THOC:ASP2"
645 60973 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/THOC:ASP3"
646 60974 5 0.0060 0.0600 0.1330 0.3350 0.1030 0.0940 "ABLA/THOC:ASP"
647 60982 5 0.0040 0.0420 0.1540 0.3540 0.0940 0.0660 "ABLA/THOC:MF2"
648 60984 5 0.0050 0.0480 0.1500 0.3880 0.1120 0.0750 "ABLA/THOC:MF"
649 61030 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/OPHO:LP0 (BGD)"
650 61033 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/OPHO:LP3"
651 62020 1 0.0090 0.0680 0.0001 0.0260 0.0860 0.1560 "ABLA/CLUN:DF0 (BGD)"
652 62023 5 0.0001 0.0310 0.0001 0.2250 0.1290 0.1940 "ABLA/CLUN:DF3"
653 62032 5 0.0420 0.1350 0.0001 0.1530 0.1540 0.4590 "ABLA/CLUN:LP2"
654 62041 5 0.0500 0.1940 0.0001 0.0960 0.1320 0.4180 "ABLA/CLUN:SF1"
655 62132 5 0.0420 0.1350 0.0001 0.1530 0.1540 0.4590 "ABLA/CLUN-CLUN:LP2"
656 62322 5 0.0100 0.0800 0.0001 0.2050 0.1080 0.1790 "ABLA/CLUN-VACA:DF2"
657 62544 5 0.0550 0.2060 0.0001 0.1330 0.1590 0.5000 "ABLA/CLUN-MEFE:SF"
658 63020 1 0.0300 0.1200 0.0001 0.0100 0.0640 0.0001 "ABLA/GATR:DF0 (BGD)"
659 63022 5 0.0120 0.0490 0.0001 0.0720 0.0660 0.0001 "ABLA/GATR:DF2"
660 63023 5 0.0130 0.0600 0.0001 0.0790 0.0790 0.0001 "ABLA/GATR:DF3"
```

```
661 63024 5 0.0130 0.0600 0.0001 0.0790 0.0790 0.0001 "ABLA/GATR:DF"
662 63030 1 0.0300 0.1200 0.0001 0.0100 0.0640 0.0001 "ABLA/GATR:LP0"
663 63032 5 0.0490 0.0830 0.0001 0.0540 0.0940 0.0001 "ABLA/GATR:LP2"
664 63033 5 0.0630 0.1010 0.0001 0.0380 0.0730 0.0001 "ABLA/GATR:LP3"
665 63040 1 0.0300 0.1200 0.0001 0.0001 0.0640 0.0001 "ABLA/GATR:SF0"
666 63041 5 0.0580 0.1200 0.0001 0.0340 0.0810 0.0001 "ABLA/GATR:SF1"
667 63044 5 0.0640 0.1270 0.0001 0.0470 0.0970 0.0001 "ABLA/GATR:SF"
668 63073 5 0.0001 0.0390 0.0001 0.0001 0.1550 0.0001 "ABLA/GATR:ASP3"
669 63523 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM:DF3"
670 63530 1 0.0001 0.1410 0.0980 0.0001 0.0750 0.0790 "ABLA/STAM:LP0"
671 63531 5 0.0001 0.1410 0.0990 0.0001 0.0950 0.1110 "ABLA/STAM:LP1"
672 63532 5 0.0001 0.0980 0.1140 0.0001 0.1110 0.1220 "ABLA/STAM:LP2"
673 63533 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM:LP3"
674 63534 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0888 "ABLA/STAM:LP"
675 63540 1 0.0001 0.1410 0.0980 0.0001 0.0750 0.0790 "ABLA/STAM:SF0"
676 63541 5 0.0001 0.1410 0.0990 0.0001 0.0950 0.1110 "ABLA/STAM:SF1"
677 63542 5 0.0001 0.0980 0.1140 0.0001 0.1110 0.1220 "ABLA/STAM:SF2"
678 63544 5 0.0001 0.1500 0.1550 0.0001 0.1140 0.1330 "ABLA/STAM:SF"
679 63552 5 0.0001 0.0169 0.1910 0.0001 0.0930 0.1910 "ABLA/STAM:WB2"
680 63553 5 0.0001 0.1640 0.1770 0.0001 0.0930 0.1950 "ABLA/STAM:WB3"
681 63554 5 0.0001 0.1640 0.1770 0.0001 0.0930 0.1950 "ABLA/STAM:WB"
682 63584 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM:MF"
683 63620 1 0.0001 0.0750 0.0790 0.0001 0.0750 0.0790 "ABLA/STAM-STAM:DF0"
684 63621 5 0.0001 0.0950 0.1110 0.0001 0.0950 0.1110 "ABLA/STAM-STAM:DF1"
685 63622 5 0.0001 0.1110 0.1220 0.0001 0.1110 0.1220 "ABLA/STAM-STAM:DF2"
686 63623 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM-STAM:DF3"
687 63624 5 0.0001 0.0860 0.0880 0.0001 0.0860 0.0880 "ABLA/STAM-STAM:DF"
688 63630 1 0.0001 0.1410 0.0980 0.0001 0.0750 0.0790 "ABLA/STAM-STAM:LP0"
689 63631 5 0.0001 0.1410 0.0990 0.0001 0.0950 0.1110 "ABLA/STAM-STAM:LP1"
690 63632 5 0.0001 0.0980 0.1140 0.0001 0.1110 0.1220 "ABLA/STAM-STAM:LP2"
691 63633 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM-STAM:LP3"
692 63634 5 0.0001 0.1200 0.1420 0.0001 0.0860 0.0880 "ABLA/STAM-STAM:LP"
693 63640 1 0.0001 0.1410 0.0980 0.0001 0.0750 0.0790 "ABLA/STAM-STAM:SF0"
694 63641 5 0.0001 0.1410 0.0990 0.0001 0.0950 0.1110 "ABLA/STAM-STAM:SF1"
695 63642 5 0.0001 0.0980 0.1140 0.0001 0.1110 0.1220 "ABLA/STAM-STAM:SF2"
696 63644 5 0.0001 0.1500 0.1550 0.0001 0.1140 0.1330 "ABLA/STAM-STAM:SF"
697 63652 5 0.0001 0.1640 0.1770 0.0001 0.0930 0.1950 "ABLA/STAM-STAM:WB2"
698 63653 5 0.0001 0.1640 0.1770 0.0001 0.0930 0.1950 "ABLA/STAM-STAM:WB3"
699 63654 5 0.0001 0.1640 0.1770 0.0001 0.0930 0.1950 "ABLA/STAM-STAM:WB"
700 64031 5 0.0420 0.2100 0.0440 0.0240 0.1430 0.0490 "ABLA/VACA:LP1"
701 64032 5 0.0350 0.1460 0.0500 0.0390 0.1660 0.0540 "ABLA/VACA:LP2"
702 64041 5 0.0120 0.2450 0.3380 0.0520 0.2030 0.3900 "ABLA/VACA:SF1 (TNF)"
703 64044 5 0.0460 0.2230 0.0680 0.0340 0.1710 0.0590 "ABLA/VACA:SF"
704 64520 1 0.0001 0.0560 0.0001 0.0001 0.1370 0.0001 "ABLA/ACGL:DF0 (TNF)"
705 64522 5 0.0001 0.0270 0.0001 0.0001 0.1410 0.0001 "ABLA/ACGL:DF2"
706 64523 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/ACGL:DF3"
707 64524 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/ACGL:DF"
708 64530 1 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/ACGL:LP0"
709 64531 5 0.0001 0.0660 0.0001 0.0001 0.1730 0.0001 "ABLA/ACGL:LP1"
710 64532 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/ACGL:LP2"
711 64533 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/ACGL:LP3"
```

```
712 64540 1 0.0001 0.0560 0.0001 0.0001 0.1370 0.0001 "ABLA/ACGL:SF0"
713 64541 5 0.0001 0.0660 0.0001 0.0001 0.1730 0.0001 "ABLA/ACGL:SF1"
714 64544 5 0.0001 0.1830 0.0001 0.0001 0.2070 0.0001 "ABLA/ACGL:SF"
715 64563 5 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/ACGL:KR"
716 64570 1 0.0001 0.0660 0.0001 0.0001 0.0660 0.0001 "ABLA/ACGL:ASP0"
717 64584 5 0.0001 0.0310 0.0001 0.0001 0.1690 0.0001 "ABLA/ACGL:MF"
718 64722 5 0.0001 0.0270 0.0001 0.0001 0.1410 0.0001 "ABLA/ACGL-PAMY:DF2"
719 64744 5 0.0001 0.1830 0.0001 0.0001 0.2070 0.0001 "ABLA/ACGL-PAMY:SF"
720 64782 5 0.0001 0.0270 0.0001 0.0001 0.1410 0.0001 "ABLA/ACGL-PAMY:MF2"
721 65023 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA:DF3"
722 65030 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA:LP0"
723 65031 5 0.0700 0.3100 0.4920 0.1370 0.2100 0.6330 "ABLA/CACA:LP1"
724 65032 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA:LP2"
725 65033 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA:LP3"
726 65034 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA:LP"
727 65040 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA:SF0"
728 65041 5 0.0700 0.3100 0.4920 0.1370 0.2100 0.6330 "ABLA/CACA:SF1"
729 65042 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA:SF2"
730 65044 5 0.0770 0.3290 0.7700 0.1900 0.2510 0.7590 "ABLA/CACA:SF"
731 65050 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CACA:WB0"
732 65052 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA:WB2"
733 65053 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA:WB3"
734 65054 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA:WB"
735 65073 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA:ASP3"
736 65122 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CACA-CACA:DF2"
737 65123 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-CACA:DF3"
738 65130 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA-CACA:LP0"
739 65131 5 0.0700 0.3100 0.4920 0.1370 0.2100 0.6330 "ABLA/CACA-CACA:LP1"
740 65132 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA-CACA:LP2"
741 65133 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-CACA:LP3"
742 65134 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-CACA:LP"
743 65140 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA-CACA:SF0"
744 65141 5 0.0700 0.3100 0.4920 0.1370 0.2100 0.6330 "ABLA/CACA-CACA:SF1"
745 65142 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA-CACA:SF2"
746 65144 5 0.0770 0.3290 0.7700 0.1900 0.2510 0.7590 "ABLA/CACA-CACA:SF"
747 65152 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA-CACA:WB2"
748 65153 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA-CACA:WB3"
749 65154 5 0.0490 0.3590 0.8770 0.1240 0.2050 1.1140 "ABLA/CACA-CACA:WB"
750 65171 5 0.0700 0.3100 0.4920 0.0001 0.0001 0.0001 "ABLA/CACA-CACA:ASP1"
751 65172 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CACA-CACA:ASP2"
752 65173 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-CACA:ASP3"
753 65184 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-CACA:MF"
754 65330 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA-GATR:LP0(BGD)"
755 65332 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA-GATR:LP2"
756 65333 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-GATR:LP3"
757 65340 1 0.0360 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA-GATR:SF0(BGD)"
758 65344 5 0.0770 0.3290 0.7700 0.1900 0.2510 0.7590 "ABLA/CACA-GATR:SF"
759 65373 5 0.0760 0.2620 0.7080 0.1530 0.1900 0.5010 "ABLA/CACA-GATR:ASP3"
760 65430 1 0.0300 0.3100 0.4870 0.0390 0.1660 0.4520 "ABLA/CACA-VACA:LP0"
761 65431 5 0.0700 0.3100 0.4920 0.1370 0.2100 0.6330 "ABLA/CACA-VACA:LP1"
762 65432 5 0.0590 0.2150 0.5660 0.2180 0.2440 0.6960 "ABLA/CACA-VACA:LP2"
```

```
763  65433  5  0.0760  0.2620  0.7080  0.1530  0.1900  0.5010  "ABLA/CACA-VACA:LP3"
764  65440  1  0.0360  0.3100  0.4870  0.0390  0.1660  0.4520  "ABLA/CACA-VACA:SF0"
765  65441  5  0.0700  0.3100  0.4920  0.1370  0.2100  0.6330  "ABLA/CACA-VACA:SF1"
766  65444  5  0.0770  0.3290  0.7700  0.1900  0.2510  0.7590  "ABLA/CACA-VACA:SF"
767  65533  5  0.0760  0.2620  0.7080  0.1530  0.1900  0.5010  "ABLA/CACA-LEGL:LP3(KRB)"
768  65544  5  0.0770  0.3290  0.7700  0.1900  0.2510  0.7590  "ABLA/CACA:-LEGL:SP (KRB)"
769  66020  1  0.0090  0.0680  0.0001  0.0260  0.0860  0.1560  "ABLA/LIBO:DF0"
770  66021  5  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "ABLA/LIBO:DF1"
771  66022  5  0.0100  0.0800  0.0001  0.2050  0.1080  0.1790  "ABLA/LIBO:DF2"
772  66023  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO:DF3"
773  66024  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO:DF"
774  66030  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "ABLA/LIBO:LP0"
775  66031  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "ABLA/LIBO:LP1"
776  66032  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "ABLA/LIBO:LP2"
777  66033  5  0.0550  0.1650  0.0001  0.1070  0.1200  0.3300  "ABLA/LIBO:LP3"
778  66034  5  0.9550  0.1650  0.0001  0.1070  0.1200  0.3300  "ABLA/LIBO:LP"
779  66040  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "ABLA/LIBO:SF0"
780  66041  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "ABLA/LIBO:SF1"
781  66042  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "ABLA/LIBO:SF2"
782  66044  5  0.0550  0.2060  0.0001  0.1330  0.1590  0.5000  "ABLA/LIBO:SF"
783  66052  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "ABLA/LIBO:WB2 "
784  66053  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "ABLA/LIBO:WB3 "
785  66070  1  0.1300  0.1150  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO:ASP0"
786  66071  5  0.0001  0.0001  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO:ASP1"
787  66072  5  0.1500  0.1150  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO:ASP2"
788  66073  5  0.1300  0.1150  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO:ASP3"
789  66074  5  0.0130  0.1150  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO:ASP"
790  66080  1  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "ABLA/LIBO:MF0 (CDB)"
791  66081  5  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "ABLA/LIBO:MF1"
792  66113  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO-LIBO:LI3"
793  66120  1  0.0090  0.0680  0.0001  0.0260  0.0860  0.1560  "ABLA/LIBO-LIBO:DF0 (BGD)"
794  66122  5  0.0100  0.0800  0.0001  0.2050  0.1080  0.1790  "ABLA/LIBO-LIBO:DF2"
795  66123  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO-LIBO:DF3"
796  66124  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO-LIBO:DF"
797  66130  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "ABLA/LIBO-LIBO:LP0"
798  66131  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "ABLA/LIBO-LIBO:LP1"
799  66132  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "ABLA/LIBO-LIBO:LP2"
800  66133  5  0.0550  0.1650  0.0001  0.1070  0.1200  0.3300  "ABLA/LIBO-LIBO:LP3"
801  66140  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "ABLA/LIBO-LIBO:SF0 (BGD)"
802  66141  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "ABLA/LIBO-LIBO:SF1"
803  66144  5  0.0550  0.2060  0.0001  0.1330  0.1590  0.5000  "ABLA/LIBO-LIBO:SF"
804  66174  5  0.0130  0.1150  0.0001  0.1930  0.1180  0.2520  "ABLA/LIBO-LIBO:ASP"
805  66320  1  0.0090  0.0680  0.0001  0.0260  0.0860  0.1560  "ABLA/LIBO-VASC:DF0"
806  66321  5  0.0090  0.0680  0.0001  0.1850  0.0860  0.1560  "ABLA/LIBO-VASC:DF1"
807  66322  5  0.0100  0.0800  0.0001  0.2050  0.1080  0.1790  "ABLA/LIBO-VASC:DF2"
808  66323  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO-VASC:DF3"
809  66324  5  0.0110  0.0920  0.0001  0.2250  0.1290  0.1940  "ABLA/LIBO-VASC:DF"
810  66330  1  0.0260  0.1940  0.0001  0.0280  0.1050  0.2980  "ABLA/LIBO-VASC:LP0"
811  66331  5  0.0500  0.1940  0.0001  0.0960  0.1320  0.4180  "ABLA/LIBO-VASC:LP1"
812  66332  5  0.0420  0.1350  0.0001  0.1530  0.1540  0.4590  "ABLA/LIBO-VASC:LP2"
813  66333  5  0.0550  0.1650  0.0001  0.1070  0.1200  0.3300  "ABLA/LIBO-VASC:LP3"
```

```
814 66334 5 0.0550 0.1650 0.0001 0.1070 0.1200 0.3300 "ABLA/LIBO-VASC:LP"
815 66340 1 0.0260 0.1940 0.0001 0.0280 0.1050 0.2980 "ABLA/LIBO-VASC:SF0"
816 66341 5 0.0500 0.1940 0.0001 0.0960 0.1320 0.4180 "ABLA/LIBO-VASC:SF1"
817 66342 5 0.0420 0.1350 0.0001 0.1530 0.1540 0.4590 "ABLA/LIBO-VASC:SF2"
818 66344 5 0.0550 0.2060 0.0001 0.0330 0.1590 0.5000 "ABLA/LIBO-VASC:SF"
819 66370 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/LIBO-VASC:ASP0"
820 66371 5 0.0001 0.0001 0.0001 0.1930 0.1180 0.2520 "ABLA/LIBO-VASC:ASP1"
821 66372 5 0.0130 0.1150 0.0001 0.1930 0.1180 0.2520 "ABLA/LIBO-VASC:ASP2"
822 66373 5 0.0130 0.1150 0.0001 0.1930 0.1180 0.2520 "ABLA/LIBO-VASC:ASP3"
823 66374 5 0.0130 0.1150 0.0001 0.1930 0.1180 0.2520 "ABLA/LIBO-VASC:ASP"
824 66384 5 0.0110 0.0920 0.0001 0.2250 0.1290 0.1940 "ABLA/LIBO-VASC:MF"
825 67032 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/MEFE:LP2"
826 67033 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/MEFE:LP3 (BGD)"
827 67034 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/MEFE:LP (BGD)"
828 67044 5 0.0380 0.1730 0.4320 0.0280 0.1400 0.4400 "ABLA/MEFE:SF"
829 67123 5 0.0380 0.1380 0.3970 0.0230 0.1060 0.2900 "ABLA/MEFE-MEFE:DF3"
830 67130 1 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/MEFE-MEFE:LP0(BGD)"
831 67132 5 0.0001 0.0460 0.0001 0.0001 0.2010 0.0001 "ABLA/MEFE-MEFE:LP2(BGD)"
832 67133 5 0.0001 0.0560 0.0001 0.0001 0.1570 0.0001 "ABLA/MEFE-MEFE:LP3"
833 67140 5 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/MEFE-MEFE:SF0"
834 67141 5 0.0450 0.1620 0.2760 0.0200 0.1170 0.3670 "ABLA/MEFE-MEFE:SF1"
835 67144 5 0.0380 0.1730 0.4320 0.0280 0.1400 0.4400 "ABLA/MEFE-MEFE:SF"
836 67153 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/MEFE-MEFE:WB3"
837 67163 5 0.0001 0.0660 0.0001 0.0001 0.1370 0.0001 "ABLA/MEFE-MEFE:KR"
838 69023 5 0.0220 0.0570 0.0001 0.1320 0.0810 0.0001 "ABLA/XETE:DF3"
839 69034 5 0.0660 0.0570 0.0001 0.0680 0.0850 0.0001 "ABLA/XETE:LP"
840 69040 1 0.0510 0.1210 0.0001 0.0160 0.0650 0.0001 "ABLA/XETE:SF0"
841 69044 5 0.0001 0.0620 0.2240 0.0001 0.0480 0.1940 "ABLA/XETE:SF"
842 69051 5 0.0001 0.1380 0.4360 0.0001 0.0880 0.3560 "ABLA/XETE:WB1"
843 69130 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/XETE-VAGL:LP0 (BGD)"
844 69132 5 0.0590 0.2260 0.6350 0.0001 0.2720 0.0001 "ABLA/XETE-VAGL:LP2"
845 69133 5 0.0760 0.2760 0.7940 0.0001 0.2120 0.0001 "ABLA/XETE-VAGL:LP3"
846 69140 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/XETE-VAGL:SF0 (BGD)"
847 69144 5 0.0770 0.3460 0.8640 0.0001 0.2820 0.0001 "ABLA/XETE-VAGL:SF"
848 69180 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/XETE-VAGL:MF0(BGD)"
849 69182 5 0.0590 0.2260 0.6350 0.0001 0.1900 0.0001 "ABLA/XETE-VAGL:MF2"
850 69222 5 0.0020 0.1000 0.3450 0.1100 0.1650 0.1670 "ABLA/XETE-VASC:DF2(BGD)"
851 69230 1 0.0060 0.2450 0.3340 0.0150 0.1600 0.2790 "ABLA/XETE-VASC:LP0"
852 69232 5 0.0100 0.1700 0.3880 0.0820 0.2360 0.4290 "ABLA/XETE-VASC:LP2"
853 69244 5 0.0130 0.2600 0.5280 0.0710 0.2430 0.4680 "ABLA/XETE-VASC:SF"
854 70123 5 0.0001 0.1000 0.4120 0.0001 0.0730 0.2560 "ABLA/ARLA:DF3"
855 70130 1 0.0001 0.1180 0.2840 0.0001 0.0640 0.2310 "ABLA/ARLA:LP0"
856 70131 5 0.0001 0.1180 0.2870 0.0001 0.0810 0.3240 "ABLA/ARLA:LP1"
857 70132 5 0.0001 0.0820 0.3300 0.0001 0.0940 0.3560 "ABLA/ARLA:LP2"
858 70133 5 0.0001 0.1000 0.4120 0.0001 0.0730 0.2560 "ABLA/ARLA:LP3"
859 70134 5 0.0001 0.0560 0.2340 0.0001 0.0840 0.4060 "ABLA/ARLA:LP"
860 70140 1 0.0001 0.1180 0.2840 0.0001 0.0640 0.2310 "ABLA/ARLA:SF0"
861 70141 5 0.0001 0.1180 0.2870 0.0001 0.0810 0.3240 "ABLA/ARLA:SF1"
862 70142 5 0.0001 0.0820 0.3300 0.0001 0.0940 0.3560 "ABLA/ARLA:SF2"
863 70144 5 0.0001 0.1250 0.4490 0.0001 0.0970 0.3880 "ABLA/ARLA:SF"
864 70150 1 0.0001 0.0890 0.2380 0.0001 0.0140 0.0920 "ABLA/ARLA:WB0"
```

```
865  70151  5  0.0001  0.1380  0.4360  0.0001  0.0880  0.3560  "ABLA/ARLA:WB1"
866  70152  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/ARLA:WB2"
867  70153  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARLA:WB3"
868  70154  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARLA:WB"
869  70163  5  0.0001  0.0890  0.2380  0.0001  0.0140  0.0920  "ABLA/ARLA:KR (BGD)"
870  70173  5  0.0001  0.1000  0.4120  0.0001  0.0730  0.2560  "ABLA/ARLA:ASP3"
871  70184  5  0.0001  0.1000  0.4120  0.0001  0.0730  0.2560  "ABLA/ARLA:MF"
872  70222  5  0.0001  0.0610  0.4120  0.0001  0.0830  0.0001  "ABLA/BERE-BERE:DF2"
873  70223  5  0.0001  0.0700  0.4120  0.0001  0.1000  0.0001  "ABLA/BERE-BERE:DF3"
874  70224  5  0.0001  0.0700  0.4120  0.0001  0.1000  0.0001  "ABLA/BERE-BERE:DF"
875  70230  1  0.0001  0.1480  0.4120  0.0001  0.0810  0.0001  "ABLA/BERE-BERE:LP0"
876  70231  5  0.0001  0.1480  0.4120  0.0001  0.1020  0.0001  "ABLA/BERE-BERE:LP1"
877  70232  5  0.0001  0.1030  0.0001  0.0001  0.1190  0.0001  "ABLA/BERE-BERE:LP2 (BGD)"
878  70233  5  0.0001  0.1260  0.4120  0.0001  0.0930  0.0001  "ABLA/BERE-BERE:LP3"
879  70241  5  0.0001  0.1480  0.4120  0.0001  0.1020  0.0001  "ABLA/BERE-BERE:SF1"
880  70244  5  0.0001  0.1580  0.4120  0.0001  0.1220  0.0001  "ABLA/BERE-BERE:SF"
881  70252  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/BERE-BERE:WB2"
882  70253  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/BERE-BERE:WB3(BGD)"
883  70254  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/BERE-BERE:WB"
884  70263  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/BERE-BERE:KR"
885  70271  5  0.0001  0.2280  0.5120  0.0001  0.1440  0.0001  "ABLA/BERE-BERE:ASP1"
886  70272  5  0.0001  0.2280  0.5120  0.0001  0.1440  0.0001  "ABLA/BERE-BERE:ASP2"
887  70282  5  0.0001  0.0610  0.5120  0.0001  0.0830  0.0001  "ABLA/BERE-BERE:MF2"
888  70320  1  0.0001  0.0520  0.0001  0.0001  0.0670  0.0001  "ABLA/BERE:DF0"
889  70321  5  0.0001  0.0520  0.0001  0.0001  0.0670  0.0001  "ABLA/BERE:DF1"
890  70322  5  0.0001  0.0610  0.0001  0.0001  0.0830  0.0001  "ABLA/BERE:DF2"
891  70323  5  0.0001  0.0700  0.0001  0.0001  0.1000  0.0001  "ABLA/BERE:DF3"
892  70324  5  0.0001  0.0700  0.0001  0.0001  0.1000  0.0001  "ABLA/BERE:DF"
893  70330  1  0.0001  0.1480  0.0001  0.0001  0.0810  0.0001  "ABLA/BERE:LP0"
894  70331  5  0.0001  0.1480  0.0001  0.0001  0.1020  0.0001  "ABLA/BERE:LP1"
895  70332  5  0.0001  0.1030  0.0001  0.0001  0.1190  0.0001  "ABLA/BERE:LP2"
896  70333  5  0.0001  0.1260  0.0001  0.0001  0.0930  0.0001  "ABLA/BERE:LP3"
897  70334  5  0.0001  0.1260  0.0001  0.0001  0.0930  0.0001  "ABLA/BERE:LP"
898  70340  1  0.0001  0.1480  0.0001  0.0001  0.0180  0.0001  "ABLA/BERE:SF0"
899  70341  5  0.0001  0.1480  0.0001  0.0001  0.1020  0.0001  "ABLA/BERE:SF1"
900  70342  5  0.0001  0.1030  0.0001  0.0001  0.1190  0.0001  "ABLA/BERE:SF2"
901  70344  5  0.0001  0.1580  0.0001  0.0001  0.1220  0.0001  "ABLA/BERE:SF"
902  70350  1  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/BERE:WB0"
903  70351  5  0.0001  0.1380  0.4360  0.0001  0.0880  0.3560  "ABLA/BERE:WB1"
904  70352  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/BERE:WB2"
905  70353  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/BERE:WB3"
906  70354  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/BERE:WB"
907  70370  1  0.0001  0.2280  0.0001  0.0001  0.1440  0.0001  "ABLA/BERE:ASP0"
908  70371  5  0.0001  0.2280  0.0001  0.0001  0.1440  0.0001  "ABLA/BERE:ASP1"
909  70372  5  0.0001  0.2280  0.0001  0.0001  0.1440  0.0001  "ABLA/BERE:ASP2"
910  70373  5  0.0001  0.2280  0.0001  0.0001  0.1440  0.0001  "ABLA/BERE:ASP3"
911  70374  5  0.0001  0.0880  0.0001  0.0001  0.0920  0.0001  "ABLA/BERE:ASP"
912  70420  1  0.0001  0.0520  0.0001  0.0001  0.0670  0.0001  "ABLA/BERE-CAGE:DF0(BGD)"
913  70421  5  0.0001  0.0520  0.0001  0.0001  0.0670  0.0001  "ABLA/BERE-CAGE:DF1"
914  70422  5  0.0001  0.0610  0.0001  0.0001  0.0830  0.0001  "ABLA/BERE-CAGE:DF2"
915  70423  5  0.0001  0.0700  0.0001  0.0001  0.1000  0.0001  "ABLA/BERE-CAGE:DF3"
```

```
916 70424 5 0.0001 0.0700 0.0001 0.0001 0.1000 0.0001 "ABLA/BERE-CAGE:DF (BGD)"
917 70430 1 0.0001 0.1480 0.0001 0.0001 0.0810 0.0001 "ABLA/BERE-CAGE:LP0"
918 70431 5 0.0001 0.1480 0.0001 0.0001 0.1020 0.0001 "ABLA/BERE-CAGE:LP1"
919 70432 5 0.0001 0.1030 0.0001 0.0001 0.1190 0.0001 "ABLA/BERE-CAGE:LP2"
920 70433 5 0.0001 0.1480 0.0001 0.0001 0.0930 0.0001 "ABLA/BERE-CAGE:LP1"
921 70434 5 0.0001 0.1260 0.0001 0.0001 0.0930 0.0001 "ABLA/BERE-CAGE:LP"
922 70440 1 0.0001 0.1480 0.0001 0.0001 0.0180 0.0001 "ABLA/BERE-CAGE:SF0"
923 70441 5 0.0001 0.1480 0.0001 0.0001 0.1020 0.0001 "ABLA/BERE-CAGE:SF1"
924 70444 5 0.0001 0.1580 0.0001 0.0001 0.1220 0.0001 "ABLA/BERE-CAGE:SF"
925 70470 1 0.0001 0.2280 0.0001 0.0001 0.1440 0.0001 "ABLA/BERE-CAGE:ASP0"
926 70472 5 0.0001 0.2280 0.0001 0.0001 0.1440 0.0001 "ABLA/BERE-CAGE:ASP2"
927 70473 5 0.0001 0.2280 0.0001 0.0001 0.1440 0.0001 "ABLA/BERE-CAGE:ASP3 "
928 70520 1 0.0001 0.0150 0.0400 0.0001 0.0200 0.0490 "ABLA/SPBE:DF0"
929 70521 5 0.0001 0.0150 0.0400 0.0001 0.0200 0.0490 "ABLA/SPBE:DF1"
930 70522 5 0.0001 0.0180 0.1190 0.0001 0.0240 0.0560 "ABLA/SPBE:DF2"
931 70523 5 0.0001 0.0200 0.1160 0.0001 0.0290 0.0630 "ABLA/SPBE:DF3"
932 70524 5 0.0001 0.0200 0.1160 0.0001 0.0290 0.0630 "ABLA/SPBE:DF"
933 70530 1 0.0001 0.0430 0.1150 0.0001 0.0240 0.0940 "ABLA/SPBE:LP0"
934 70531 5 0.0001 0.0430 0.1160 0.0001 0.0300 0.1310 "ABLA/SPBE:LP1"
935 70532 5 0.0001 0.0300 0.1340 0.0001 0.0350 0.1440 "ABLA/SPBE:LP2"
936 70533 5 0.0001 0.0370 0.1680 0.0001 0.0270 0.1040 "ABLA/SPBE:LP3"
937 70534 5 0.0001 0.0570 0.1680 0.0001 0.0270 0.1040 "ABLA/SPBE:LP"
938 70540 1 0.0001 0.0430 0.1150 0.0001 0.0240 0.0940 "ABLA/SPBE:SF0"
939 70541 5 0.0001 0.0430 0.1160 0.0001 0.0300 0.1310 "ABLA/SPBE:SF1"
940 70542 5 0.0001 0.0300 0.1340 0.0001 0.0350 0.1440 "ABLA/SPBE:SF2"
941 70544 5 0.0001 0.0460 0.1820 0.0001 0.0360 0.1570 "ABLA/SPBE:SF"
942 70550 1 0.0001 0.0890 0.2380 0.0001 0.0140 0.1920 "ABLA/SPBE:WB0"
943 70551 5 0.0001 0.1380 0.4360 0.0001 0.0880 0.3560 "ABLA/SPBE:WB1"
944 70552 5 0.0001 0.1380 0.4750 0.0001 0.0840 0.4630 "ABLA/SPBE:WB2"
945 70553 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/SPBE:WB3"
946 70554 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/SPBE:WB"
947 70570 1 0.0001 0.0080 0.0140 0.0001 0.0050 0.0260 "ABLA/SPBE:ASP0"
948 70571 5 0.0001 0.0080 0.0140 0.0001 0.0050 0.0260 "ABLA/SPBE:ASP1"
949 70572 5 0.0001 0.0080 0.0140 0.0001 0.0050 0.0260 "ABLA/SPBE:ASP2"
950 70573 5 0.0001 0.0080 0.0140 0.0001 0.0050 0.0260 "ABLA/SPBE:ASP3"
951 70574 5 0.0001 0.0260 0.1030 0.0001 0.0270 0.0790 "ABLA/SPBE:ASP"
952 70733 5 0.0001 0.1000 0.4120 0.0001 0.0730 0.2560 "ABLA/PERA:LP3"
953 70740 1 0.0001 0.1180 0.2840 0.0001 0.0640 0.2310 "ABLA/PERA:SF0"
954 70741 5 0.0001 0.1180 0.2870 0.0001 0.0810 0.3240 "ABLA/PERA:SF1"
955 70744 5 0.0001 0.1250 0.4490 0.0001 0.0970 0.3880 "ABLA/PERA:SF"
956 70752 5 0.0001 0.1380 0.4750 0.0001 0.0840 0.4630 "ABLA/PERA:WB2"
957 70753 5 0.0001 0.1370 0.5120 0.0001 0.0790 0.5700 "ABLA/PERA:WB3"
958 70770 1 0.0001 0.1180 0.2840 0.0001 0.0640 0.2310 "ABLA/PERA:ASP0"
959 71044 5 0.0001 0.0620 0.2240 0.0001 0.0480 0.1940 "ABLA/XETE:SF"
960 72013 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:LI3 (BGD)"
961 72020 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/VAGL:DF0"
962 72021 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL:DF1"
963 72022 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL:DF2"
964 72023 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:DF3"
965 72024 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:DF"
966 72030 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL:LP0"
```

```
 967 72031 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL:LP1"
 968 72032 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL:LP2"
 969 72033 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:LP3"
 970 72034 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:LP"
 971 72040 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/VAGL:SF0"
 972 72041 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL:SF1"
 973 72042 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL:SF2"
 974 72044 5 0.0770 0.3460 0.8640 0.0560 0.2800 0.8800 "ABLA/VAGL:SF"
 975 72050 1 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VAGL:WB0"
 976 72051 5 0.0001 0.2560 0.7520 0.0001 0.3090 0.3970 "ABLA/VAGL:WB1"
 977 72052 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA/VAGL:WB2"
 978 72053 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL:WB3"
 979 72054 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL:WB"
 980 72070 1 0.0360 0.3250 0.5460 0.0120 -0.1850 0.5240 "ABLA/VAGL:ASP0"
 981 72071 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL:ASP1"
 982 72072 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL:ASP2"
 983 72073 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:ASP3"
 984 72074 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:ASP"
 985 72080 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/VAGL:MF0 (BGD)"
 986 72082 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL:MF2"
 987 72084 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL:MF"
 988 72113 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:LI3"
 989 72120 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-VASC:DF0"
 990 72121 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:DF1"
 991 72122 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VASC:DF2"
 992 72123 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:DF3"
 993 72124 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:DF"
 994 72130 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-VASC:LP0"
 995 72131 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:LP1"
 996 72132 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VASC:LP2"
 997 72133 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:LP3"
 998 72134 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:LP"
 999 72140 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-VASC:SF0"
1000 72141 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:SF1"
1001 72142 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VASC:SF2"
1002 72144 5 0.0770 0.3460 0.8640 0.0560 0.2800 0.8800 "ABLA/VAGL-VASC:SF"
1003 72150 1 0.0001 0.0980 0.1560 0.0001 -0.0830 0.1290 "ABLA/VAGL-VASC:WB0"
1004 72151 5 0.0001 0.2560 0.7520 0.0001 0.3090 0.3970 "ABLA/VAGL-VASC:WB1"
1005 72152 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA/VAGL-VASC:WB2"
1006 72153 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL-VASC:WB3"
1007 72154 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL-VASC:WB"
1008 72163 5 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VAGL-VASC:KR"
1009 72170 1 0.0001 0.0001 0.0001 0.0120 0.1850 0.5240 "ABLA/VAGL-VASC:ASP0"
1010 72171 5 0.0410 0.2340 0.7340 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:ASP1"
1011 72172 5 0.0001 0.0001 0.0001 0.0650 0.2720 0.8070 "ABLA/VAGL-VASC:ASP2"
1012 72173 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:ASP3"
1013 72174 5 0.0460 0.2120 0.5810 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:ASP"
1014 72180 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:MF0"
1015 72181 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VASC:MF1"
1016 72182 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VASC:MF2"
1017 72184 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VASC:MF"
```

```
1018 72220 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-PAMY:DF0"
1019 72221 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-PAMY:DF1"
1020 72222 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-PAMY:DF2"
1021 72223 5 0.0960 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-PAMY:DF3"
1022 72224 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.8070 "ABLA/VAGL-PAMY:DF"
1023 72230 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/VAGL-PAMY:LP0"
1024 72231 5 0.0700 0.3250 0.5220 0.0410 0.2340 0.7340 "ABLA/VAGL-PAMY:LP1"
1025 72232 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-PAMY:LP2"
1026 72233 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-PAMY:LP3"
1027 72240 1 0.0360 0.3250 0.5460 0.0120 0.0850 0.5240 "ABLA/VAGL-PAMY:SF0"
1028 72241 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-PAMY:SF1"
1029 72244 5 0.0770 0.3460 0.8640 0.0560 0.2800 0.8800 "ABLA/VAGL-PAMY:SF"
1030 72252 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA/VAGL-PAMY:WB2"
1031 72253 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL-PAMY:WB3"
1032 72263 5 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VAGL-PAMY:KR"
1033 72270 1 0.0360 0.3250 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-PAMY:ASP0"
1034 72273 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-PAMY:ASP3"
1035 72280 5 0.0700 0.3250 0.5520 0.0700 0.3250 0.5520 "ABLA/VAGL-PAMY:MF0"
1036 72281 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-PAMY:MF1"
1037 72282 5 0.0590 0.2260 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-PAMY:MF2"
1038 72284 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-PAMY:MF"
1039 72320 1 0.0360 0.1200 0.5460 0.0120 0.1520 0.5240 "ABLA/VAGL-VAGL:DF0"
1040 72321 5 0.0700 0.1200 0.5520 0.0410 0.1520 0.7340 "ABLA/VAGL-VAGL:DF1"
1041 72322 5 0.0590 0.1410 0.6350 0.0650 0.1900 0.8070 "ABLA/VAGL-VAGL:DF2"
1042 72323 5 0.0760 0.1620 0.7940 0.0460 0.2280 0.5810 "ABLA/VAGL-VAGL:DF3"
1043 72324 5 0.0760 0.1620 0.7940 0.0460 0.2280 0.5810 "ABLA/VAGL-VAGL:DF"
1044 72330 1 0.0360 0.3440 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-VAGL:LP0"
1045 72331 5 0.0700 0.3440 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VAGL:LP1"
1046 72332 5 0.0590 0.2390 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VAGL:LP2"
1047 72333 5 0.0760 0.2920 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VAGL:LP3"
1048 72334 5 0.0760 0.2920 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VAGL:LP"
1049 72340 1 0.0360 0.3440 0.5460 0.0120 0.1850 0.5240 "ABLA/VAGL-VAGL:SF0"
1050 72341 5 0.0700 0.3440 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VAGL:SF1"
1051 72342 5 0.0590 0.2390 0.6350 0.0650 0.2720 0.8070 "ABLA/VAGL-VAGL:SF2"
1052 72344 5 0.0760 0.3660 0.7940 0.0560 0.2800 0.8800 "ABLA/VAGL-VAGL:SF"
1053 72350 1 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VAGL-VAGL:WB0"
1054 72351 5 0.0001 0.2560 0.7520 0.0001 0.3090 0.3970 "ABLA/VAGL-VAGL:WB1"
1055 72352 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA/VAGL-VAGL:WB2"
1056 72353 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL-VAGL:WB3"
1057 72354 5 0.0490 0.3770 0.9840 0.0370 0.2280 1.2910 "ABLA/VAGL-VAGL:WB"
1058 72370 1 0.0001 0.0001 0.0001 0.0120 0.1850 0.5240 "ABLA/VAGL-VAGL:ASP0"
1059 72371 5 0.0001 0.0001 0.0001 0.0410 0.2340 0.7340 "ABLA/VAGL-VAGL:ASP1"
1060 72372 5 0.0001 0.0001 0.0001 0.0650 0.2720 0.8070 "ABLA/VAGL-VAGL:ASP2"
1061 72373 5 0.0760 0.2760 0.7940 0.0460 0.2120 0.5810 "ABLA/VAGL-VAGL:ASP3"
1062 72374 5 0.0001 0.2030 0.0001 0.0460 0.2090 0.5810 "ABLA/VAGL-VAGL:ASP"
1063 72380 5 0.0700 0.3250 0.5520 0.0410 0.2340 0.7340 "ABLA/VAGL-VAGL:MF0 "
1064 72382 5 0.0590 0.1410 0.6350 0.0650 0.1900 0.8070 "ABLA/VAGL-VAGL:MF2"
1065 72384 5 0.0760 0.1620 0.7940 0.0460 0.2280 0.5810 "ABLA/VAGL-VAGL:MF"
1066 73020 1 0.0020 0.0850 0.1160 0.0140 0.1320 0.1460 "ABLA/VASC:DF0"
1067 73021 5 0.0020 0.0850 0.1160 0.0990 0.1320 0.1460 "ABLA/VASC:DF1"
1068 73022 5 0.0020 0.1000 0.3450 0.1100 0.1650 0.1670 "ABLA/VASC:DF2"
```

```
1069  73023  5  0.0030  0.1160  0.3380  0.1200  0.1980  0.1890  "ABLA/VASC:DF3"
1070  73024  5  0.0030  0.1160  0.3880  0.1200  0.1980  0.1890  "ABLA/VASC:DF"
1071  73030  1  0.0060  0.2450  0.3340  0.0150  0.1600  0.2790  "ABLA/VASC:LP0"
1072  73031  5  0.0120  0.2450  0.3380  0.0520  0.2030  0.3900  "ABLA/VASC:LP1"
1073  73032  5  0.0100  0.1700  0.3880  0.0820  0.2360  0.4290  "ABLA/VASC:LP2"
1074  73033  5  0.0130  0.2070  0.4850  0.0570  0.1840  0.3090  "ABLA/VASC:LP3"
1075  73034  5  0.0080  0.1160  0.2750  0.0620  0.2100  0.4890  "ABLA/VASC:LP"
1076  73040  1  0.0060  0.2450  0.3340  0.0150  0.1600  0.2790  "ABLA/VASC:SF0"
1077  73041  5  0.0120  0.2450  0.3380  0.0520  0.2030  0.3900  "ABLA/VASC:SF1"
1078  73042  5  0.0100  0.1700  0.3880  0.0820  0.2360  0.4290  "ABLA/VASC:SF2"
1079  73044  5  0.0130  0.2600  0.5280  0.0710  0.2430  0.4680  "ALBA/VASC:SF"
1080  73050  1  0.0001  0.0980  0.1560  0.0001  0.0830  0.1290  "ABLA/VASC:WB0"
1081  73051  5  0.0001  0.2560  0.7520  0.0001  0.3090  0.3970  "ABLA/VASC:WB1"
1082  73052  5  0.0001  0.2540  0.8590  0.0001  0.2970  0.6840  "ABLA/VASC:WB2"
1083  73053  5  0.0001  0.2510  0.9760  0.0001  0.2860  0.9920  "ABLA/VASC:WB3"
1084  73054  5  0.0001  0.2510  0.9760  0.0001  0.2860  0.9920  "ABLA/VASC:WB"
1085  73073  5  0.0030  0.1440  0.2990  0.1030  0.1820  0.2360  "ABLA/VASC:ASP3"
1086  73074  5  0.0030  0.1440  0.2990  0.1030  0.1820  0.2360  "ABLA/VASC:ASP"
1087  73120  1  0.0080  0.0730  0.0150  0.0070  0.0930  0.0180  "ABLA/VASC-CARU:DF0"
1088  73121  5  0.0080  0.0730  0.0150  0.0470  0.0930  0.0180  "ABLA/VASC-CARU:DF1"
1089  73122  5  0.0080  0.0860  0.0440  0.0520  0.1160  0.0210  "ABLA/VASC-CARU:DF2"
1090  73123  5  0.0090  0.0990  0.0440  0.0570  0.1390  0.0240  "ABLA/VASC-CARU:DF3"
1091  73124  5  0.0090  0.0990  0.0440  0.0570  0.1390  0.0240  "ABLA/VASC-CARU:DF"
1092  73130  1  0.0220  0.2100  0.0430  0.0070  0.1130  0.0350  "ABLA/VASC-CARU:LP0"
1093  73131  5  0.0420  0.2100  0.0440  0.0240  0.1430  0.0490  "ABLA/VASC-CARU:LP1"
1094  73132  5  0.0350  0.1460  0.0500  0.0390  0.1660  0.0540  "ABLA/VASC-CARU:LP2"
1095  73133  5  0.0450  0.1780  0.0620  0.0170  0.1290  0.0390  "ABLA/VASC-CARU:LP3"
1096  73134  5  0.0280  0.0990  0.0360  0.0300  0.1480  0.0620  "ABLA/VASC-CARU:LP"
1097  73140  1  0.0220  0.2100  0.0430  0.0070  0.1130  0.0350  "ABLA/VASC-CARU:SF0"
1098  73141  5  0.0420  0.2100  0.0440  0.0240  0.1430  0.0490  "ABLA/VASC-CARU:SF1"
1099  73142  5  0.0350  0.1460  0.0500  0.0390  0.1660  0.0540  "ABLA/VASC-CARU:SF2"
1100  73143  5  0.0460  0.2230  0.0680  0.0340  0.1710  0.0590  "ABLA/VASC-CARU:SF3"
1101  73144  5  0.0460  0.2230  0.0680  0.0340  0.1710  0.0590  "ABLA/VASC-CARU:SF"
1102  73153  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "ABLA/VASC-CARU:WB3"
1103  73170  1  0.0180  0.1050  0.0080  0.0100  0.0660  0.0120  "ABLA/VASC-CARU:ASP0"
1104  73171  5  0.0180  0.1050  0.0080  0.0100  0.0660  0.0120  "ABLA/VASC-CARU:ASP1"
1105  73172  5  0.0180  0.1050  0.0080  0.0100  0.0660  0.0120  "ABLA/VASC-CARU:ASP2"
1106  73173  5  0.0180  0.1050  0.0080  0.0100  0.0660  0.0120  "ABLA/VASC-CARU:ASP3"
1107  73174  5  0.0110  0.1240  0.0380  0.0490  0.1280  0.0300  "ABLA/VASC-CARU:ASP"
1108  73180  1  0.0080  0.0730  0.0150  0.0070  0.0930  0.0180  "ABLA/VASC-CARU:MF0"
1109  73181  5  0.0080  0.0730  0.0150  0.0470  0.0930  0.0180  "ABLA/VASC-CARU:MF1"
1110  73182  5  0.0080  0.0860  0.0440  0.0520  0.1160  0.0210  "ABLA/VASC-CARU:MF2"
1111  73184  5  0.0090  0.0990  0.0440  0.0570  0.1390  0.0240  "ABLA/VASC-CARU:MF"
1112  73220  1  0.0020  0.0850  0.1160  0.0140  0.1320  0.1460  "ABLA/VASC-VASC:DF0"
1113  73221  5  0.0020  0.0850  0.1160  0.0990  0.1320  0.1460  "ABLA/VASC-VASC:DF1"
1114  73222  5  0.0020  0.1000  0.3450  0.1100  0.1650  0.1670  "ABLA/VASC-VASC:DF2"
1115  73223  5  0.0030  0.1160  0.3380  0.1200  0.1980  0.1890  "ABLA/VASC-VASC:DF3"
1116  73224  5  0.0030  0.1160  0.3880  0.1200  0.1980  0.1890  "ABLA/VASC-VASC:DF"
1117  73230  1  0.0060  0.2450  0.3340  0.0150  0.1600  0.2790  "ABLA/VASC-VASC:LP0"
1118  73231  5  0.0120  0.2450  0.3380  0.0520  0.2030  0.3900  "ABLA/VASC-VASC:LP1"
1119  73232  5  0.0100  0.1700  0.3880  0.0820  0.2360  0.4290  "ABLA/VASC-VASC:LP2"
```

```
1120 73233 5 0.0130 0.2070 0.4850 0.0570 0.1840 0.3090 "ABLA/VASC-VASC:LP3"
1121 73234 5 0.0080 0.1160 0.2750 0.0620 0.2100 0.4890 "ABLA/VASC-VASC:LP"
1122 73240 1 0.0060 0.2450 0.3340 0.0150 0.1600 0.2790 "ABLA/VASC-VASC:SF0"
1123 73241 5 0.0120 0.2450 0.3380 0.0520 0.2030 0.3900 "ABLA/VASC-VASC:SF1"
1124 73242 5 0.0100 0.1700 0.3880 0.0820 0.2360 0.4290 "ABLA/VASC-VASC:SF2"
1125 73244 5 0.0130 0.2600 0.5280 0.0710 0.2430 0.4680 "ABLA/VASC-VASC:SF"
1126 73250 1 0.0001 0.0001 0.0001 0.0001 0.0830 0.1290 "ABLA/VASC-VASC:WB0"
1127 73251 5 0.0001 0.0001 0.0001 0.0001 0.3090 0.3970 "ABLA/VASC-VASC:WB1"
1128 73252 5 0.0001 0.0001 0.0001 0.0001 0.2970 0.6840 "ABLA/VASC-VASC:WB2"
1129 73253 5 0.0001 0.0001 0.0001 0.0001 0.2860 0.9920 "ABLA/VASC-VASC:WB3"
1130 73254 5 0.0001 0.0001 0.0001 0.0001 0.2860 0.9920 "ABLA/VASC-VASC:WB"
1131 73263 5 0.0060 0.2450 0.3340 0.0001 0.2370 0.0500 "ABLA/VASC-VASC:KR"
1132 73272 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/VASC-VASC:ASP2"
1133 73273 5 0.0030 0.1440 0.2990 0.1030 0.1820 0.2360 "ABLA/VASC-VASC:ASP3"
1134 73274 5 0.0030 0.1440 0.2990 0.1030 0.1820 0.2360 "ABLA/VASC-VASC:ASP"
1135 73280 1 0.0020 0.0850 0.1160 0.0990 0.1320 0.1460 "ABLA/VASC-VASC:MF0"
1136 73281 5 0.0020 0.0850 0.1160 0.0990 0.1320 0.1460 "ABLA/VASC-VASC:MF1"
1137 73284 5 0.0030 0.1160 0.3880 0.1200 0.1980 0.1890 "ABLA/VASC-VASC:MF (BGD)"
1138 73323 5 0.0050 0.0480 0.1500 0.3880 0.1120 0.0750 "ABLA/VASC-THOC:DF3"
1139 73330 1 0.0120 0.1020 0.1490 0.0480 0.0910 0.1100 "ABLA/VASC-THOC:LP0"
1140 73331 5 0.0230 0.1020 0.1500 0.1660 0.1150 0.1550 "ABLA/VASC-THOC:LP1"
1141 73332 5 0.0190 0.0710 0.1730 0.2640 0.1340 0.1700 "ABLA/VASC-THOC:LP2"
1142 73333 5 0.0240 0.0870 0.1220 0.1850 0.1040 0.1220 "ABLA/VASC-THOC:LP3"
1143 73334 5 0.0240 0.0870 0.1220 0.1850 0.1040 0.1220 "ABLA/VASC-THOC:LP"
1144 73340 1 0.0120 0.1020 0.1490 0.0480 0.0910 0.1100 "ABLA/VASC-THOC:SF0"
1145 73341 5 0.0230 0.1020 0.1500 0.1660 0.1150 0.1550 "ABLA/VASC-THOC:SF1"
1146 73344 5 0.0250 0.1090 0.2350 0.2300 0.1380 0.1850 "ABLA/VASC-THOC:SF"
1147 73353 5 0.0010 0.1100 0.2000 0.1500 0.1120 0.2720 "ABLA/VASC-THOC:WB3"
1148 73370 1 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/VASC-THOC:ASP0"
1149 73384 5 0.0050 0.0480 0.1500 0.3880 0.1120 0.0750 "ABLA/VASC-THOC:MF"
1150 73420 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/VASC-PIAL:DF0"
1151 73422 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA/VASC-PIAL:DF2 (TNF)"
1152 73423 5 0.0001 0.1490 0.6830 0.0001 0.2630 0.1190 "ABLA/VASC-PIAL:DF3"
1153 73424 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/VASC-PIAL:DF4 (TNF)"
1154 73430 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA/VASC-PIAL:LP0"
1155 73431 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA/VASC-PIAL:LP1"
1156 73432 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA/VASC-PIAL:LP2"
1157 73433 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "ABLA/VASC-PIAL:LP3"
1158 73434 5 0.0001 0.0001 0.0001 0.0001 0.2630 0.1190 "ABLA/VASC-PIAL:LP"
1159 73440 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA/VASC-PIAL:SF0"
1160 73441 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA/VASC-PIAL:SF1"
1161 73442 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA/VASC-PIAL:SF2"
1162 73444 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/VASC-PIAL:SF"
1163 73450 1 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VASC-PIAL:WB0"
1164 73451 5 0.0001 0.2560 0.7520 0.0001 0.3090 0.3970 "ABLA/VASC-PIAL:WB1"
1165 73452 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA/VASC-PIAL:WB2"
1166 73453 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/VASC-PIAL:WB3"
1167 73454 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/VASC-PIAL:WB"
1168 73460 1 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VASC-PIAL:KRB(CDB)"
1169 73463 5 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA/VASC-PIAL:KR"
1170 73480 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA/VASC-PIAL:MF0(BGD)"
```

```
1171 73481 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA/VASC-PIAL:MF1"
1172 73482 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA/VASC-PIAL:MF2"
1173 73484 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "ABLA/VASC-PIAL:MF"
1174 74020 1 0.0001 0.0420 0.0001 0.0001 0.0660 0.0001 "ABLA/ALSI:DF0"
1175 74022 5 0.0001 0.1130 0.0001 0.0330 0.1360 0.4040 "ABLA/ALSI:DF2"
1176 74023 5 0.0001 0.1310 0.0001 0.0001 0.1140 0.0001 "ABLA/ALSI:DF3"
1177 74030 1 0.0180 0.1620 0.2730 0.0060 0.0920 0.2620 "ABLA/ALSI:LP0"
1178 74031 5 0.0350 0.1620 0.2760 0.0200 0.1170 0.3670 "ABLA/ALSI:LP1"
1179 74032 5 0.0290 0.1130 0.3180 0.0320 0.1360 0.4040 "ABLA/ALSI:LP2"
1180 74033 5 0.0060 0.1380 0.3970 0.0280 0.1060 0.2900 "ABLA/ALSI:LP3"
1181 74040 1 0.0180 0.1620 0.2620 0.0060 0.0920 0.2620 "ABLA/ALSI:SF0"
1182 74044 5 0.0060 0.1730 0.4320 0.0360 0.1400 0.4400 "ABLA/ALSI:SF"
1183 74080 1 0.0001 0.0420 0.0001 0.0001 0.0660 0.0001 "ABLA/ALSI:MF0 (BGD)"
1184 74084 5 0.0001 0.1130 0.0001 0.0330 0.1360 0.4040 "ABLA/ALSI:MF"
1185 74520 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/JUCO:DF0"
1186 74521 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/JUCO:DF1"
1187 74522 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/JUCO:DF2"
1188 74523 5 0.0001 0.0001 0.0001 0.0001 0.0730 0.2680 "ABLA/JUCO:DF3"
1189 74524 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/JUCO:DF"
1190 74530 1 0.0001 0.1180 0.2970 0.0001 0.0640 0.2420 "ABLA/JUCO:LP0"
1191 74531 5 0.0001 0.1180 0.3000 0.0001 0.0810 0.3380 "ABLA/JUCO:LP1"
1192 74532 5 0.0001 0.0820 0.3450 0.0001 0.0940 0.3720 "ABLA/JUCO:LP2"
1193 74533 5 0.0001 0.1000 0.4310 0.0001 0.0730 0.2680 "ABLA/JUCO:LP3"
1194 74534 5 0.0001 0.0560 0.2450 0.0001 0.0840 0.4240 "ABLA/JUCO:LP"
1195 74540 1 0.0001 0.1180 0.2970 0.0001 0.0640 0.2420 "ABLA/JUCO:SF0"
1196 74541 5 0.0001 0.1180 0.3000 0.0001 0.0810 0.3380 "ABLA/JUCO:SF1"
1197 74542 5 0.0001 0.0820 0.3450 0.0001 0.0940 0.3720 "ABLA/JUCO:SF2"
1198 74544 5 0.0001 0.1250 0.4690 0.0001 0.0970 0.4050 "ABLA/JUCO:SF"
1199 74550 1 0.0001 0.0890 0.2480 0.0001 0.0140 0.2010 "ABLA/JUCO:WB0"
1200 74551 5 0.0001 0.1380 0.4550 0.0001 0.0880 0.3720 "ABLA/JUCO:WB1"
1201 74552 5 0.0001 0.1380 0.4970 0.0001 0.0840 0.4840 "ABLA/JUCO:WB2"
1202 74553 5 0.0001 0.1370 0.5350 0.0001 0.0790 0.5950 "ABLA/JUCO:WB3"
1203 74554 5 0.0001 0.1370 0.5350 0.0001 0.0790 0.5950 "ABLA/JUCO:WB"
1204 74563 5 0.0001 0.0890 0.2480 0.0001 0.0140 0.2010 "ABLA/JUCO:KR"
1205 74570 1 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/JUCO:ASP0"
1206 74571 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/JUCO:ASP1"
1207 74572 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/JUCO:ASP2"
1208 74573 5 0.0001 0.0310 0.0001 0.0001 0.0780 0.0001 "ABLA/JUCO:ASP3"
1209 74574 5 0.0001 0.0310 0.0001 0.0001 0.0780 0.0001 "ABLA/JUCO:ASP"
1210 74581 5 0.0001 0.1180 0.3000 0.0001 0.0570 0.0001 "ABLA/JUCO:MF1"
1211 75020 1 0.0001 0.0180 0.0001 0.0001 0.0570 0.0001 "ABLA/CARU:DF0"
1212 75021 5 0.0001 0.0180 0.0001 0.0001 0.0570 0.0001 "ABLA/CARU:DF1"
1213 75022 5 0.0001 0.0220 0.0001 0.0001 0.0710 0.0001 "ABLA/CARU:DF2"
1214 75023 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU:DF3"
1215 75024 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU:DF"
1216 75030 1 0.0001 0.0530 0.0001 0.0001 0.0690 0.0001 "ABLA/CARU:LP0"
1217 75031 5 0.0001 0.0530 0.0001 0.0001 0.0880 0.0001 "ABLA/CARU:LP1"
1218 75032 5 0.0001 0.0370 0.0001 0.0001 0.1020 0.0001 "ABLA/CARU:LP2"
1219 75033 5 0.0001 0.0450 0.0001 0.0001 0.0800 0.0001 "ABLA/CARU:LP3"
1220 75034 5 0.0001 0.0250 0.0001 0.0001 0.0910 0.0001 "ABLA/CARU:LP"
1221 75040 1 0.0001 0.0530 0.0001 0.0001 0.0690 0.0001 "ABLA/CARU:SF0"
```

```
1222 75041 5 0.0001 0.0530 0.0001 0.0001 0.0880 0.0001 "ABLA/CARU:SF1"
1223 75042 5 0.0001 0.0370 0.0001 0.0001 0.1020 0.0001 "ABLA/CARU:SF2"
1224 75044 5 0.0001 0.0570 0.0001 0.0001 0.1050 0.0001 "ABLA/CARU:SF"
1225 75050 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CARU:WB0"
1226 75052 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CARU:WB2"
1227 75053 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CARU:WB3"
1228 75064 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU:OW"
1229 75070 1 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU:ASP0"
1230 75071 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU:ASP1"
1231 75072 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU:ASP2"
1232 75073 5 0.0001 0.0310 0.0001 0.0001 0.0780 0.0001 "ABLA/CARU:ASP3"
1233 75074 5 0.0001 0.0310 0.0001 0.0001 0.0780 0.0001 "ABLA/CARU:ASP"
1234 75080 1 0.0001 0.0180 0.0001 0.0001 0.0570 0.0001 "ABLA/CARU:MF0 (BGD)"
1235 75082 5 0.0001 0.0220 0.0001 0.0001 0.0710 0.0001 "ABLA/CARU:MF2"
1236 75084 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU:MF"
1237 75120 1 0.0001 0.0180 0.0001 0.0001 0.0570 0.0001 "ABLA/CARU-CARU:DF0"
1238 75121 5 0.0001 0.0180 0.0001 0.0001 0.0570 0.0001 "ABLA/CARU-CARU:DF1"
1239 75122 5 0.0001 0.0220 0.0001 0.0001 0.0710 0.0001 "ABLA/CARU-CARU:DF2"
1240 75123 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU-CARU:DF3"
1241 75124 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU-CARU:DF"
1242 75130 1 0.0001 0.0530 0.0001 0.0001 0.0690 0.0001 "ABLA/CARU-CARU:LP0"
1243 75131 5 0.0001 0.0530 0.0001 0.0001 0.0880 0.0001 "ABLA/CARU-CARU:LP1"
1244 75132 5 0.0001 0.0370 0.0001 0.0001 0.1020 0.0001 "ABLA/CARU-CARU:LP2"
1245 75133 5 0.0001 0.0450 0.0001 0.0001 0.0800 0.0001 "ABLA/CARU-CARU:LP3"
1246 75134 5 0.0001 0.0250 0.0001 0.0001 0.0910 0.0001 "ABLA/CARU-CARU:LP"
1247 75140 1 0.0001 0.0530 0.0001 0.0001 0.0690 0.0001 "ABLA/CARU-CARU:SF0"
1248 75141 5 0.0001 0.0530 0.0001 0.0001 0.0880 0.0001 "ABLA/CARU-CARU:SF1"
1249 75142 5 0.0001 0.0370 0.0001 0.0001 0.1020 0.0001 "ABLA/CARU-CARU:SF2"
1250 75144 5 0.0001 0.0570 0.0001 0.0001 0.1050 0.0001 "ABLA/CARU-CARU:SF"
1251 75150 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CARU-CARU:WB0"
1252 75153 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA/CARU-CARU:WB3 "
1253 75170 1 0.0001 0.0530 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU-CARU:ASP0"
1254 75171 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU-CARU:ASP1"
1255 75172 5 0.0001 0.0150 0.0001 0.0001 0.0600 0.0001 "ABLA/CARU-CARU:ASP2"
1256 75173 5 0.0001 0.0150 0.0001 0.0001 0.0780 0.0001 "ABLA/CARU-CARU:ASP3"
1257 75174 5 0.0001 0.0310 0.0001 0.0001 0.0780 0.0001 "ABLA/CARU-CARU:ASP"
1258 75182 5 0.0001 0.0220 0.0001 0.0001 0.0710 0.0001 "ABLA/CARU-CARU:MF2"
1259 75184 5 0.0001 0.0250 0.0001 0.0001 0.0860 0.0001 "ABLA/CARU-CARU:MF"
1260 75232 5 0.0001 0.0370 0.0001 0.0001 0.1020 0.0001 "ABLA/CARU-PAMY:LP2"
1261 75233 5 0.0001 0.0450 0.0001 0.0001 0.0800 0.0001 "ABLA/CARU-PAMY:LP3"
1262 75244 5 0.0001 0.0570 0.0001 0.0001 0.1050 0.0001 "ABLA/CARU-PAMY:SF"
1263 76022 5 0.0040 0.0420 0.1540 0.3540 0.1900 0.0660 "ABLA/OSCH:DF2"
1264 76023 5 0.0050 0.0480 0.1500 0.3880 0.2280 0.0750 "ABLA/OSCH:DF3"
1265 76024 5 0.0050 0.0480 0.1500 0.3880 0.2280 0.0750 "ABLA/OSCH:DF"
1266 76030 1 0.0880 0.0760 0.0001 0.0001 0.0420 0.0001 "ABLE/OSCH:LP0 (TNF)"
1267 76032 5 0.0190 0.0710 0.1730 0.2640 0.1340 0.1700 "ABLA/OSCH:LP2"
1268 76041 5 0.0230 0.1020 0.1500 0.1660 0.1150 0.1550 "ABLA/OSCH:SF1"
1269 76044 5 0.0250 0.1090 0.2350 0.2300 0.1380 0.1850 "ABLA/OSCH:SF"
1270 76053 5 0.0010 0.1100 0.2000 0.1500 0.1120 0.2720 "ABLA/OSCH:WB3"
1271 76070 1 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/OSCH:ASP0"
1272 76071 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ABLA/OSCH:ASP1"
```

```
1273  76072  5  0.0040  0.0410  0.0120  0.2230  0.0720  0.1250  "ABLA/OSCH:ASP2"
1274  76144  5  0.0250  0.1090  0.2350  0.2300  0.1380  0.1850  "ABLA/OSCH-PAMY:SF"
1275  76170  1  0.0040  0.0410  0.0120  0.2230  0.0720  0.1250  "ABLA/OSCH-PAMY:ASP0"
1276  76173  5  0.0040  0.0410  0.0120  0.2230  0.0720  0.1250  "ABLA/OSCH-PAMY:ASP3"
1277  76184  5  0.0050  0.0480  0.1500  0.3880  0.2280  0.0750  "ABLA/OSCH-PAMY:MF"
1278  76220  1  0.0340  0.0360  0.0001  0.0160  0.0340  0.0001  "ABLA/OSCH-OSCH:DF0"
1279  76222  5  0.0040  0.0420  0.1540  0.3540  0.1900  0.0660  "ABLA/OSCH-OSCH:DF2"
1280  76223  5  0.0050  0.0480  0.1500  0.3880  0.2280  0.0750  "ABLA/OSCH-OSCH:DF3"
1281  76224  5  0.0050  0.0480  0.1500  0.3880  0.2280  0.0750  "ABLA/OSCH-OSCH:DF (BGD)"
1282  76230  1  0.0120  0.1020  0.1490  0.0480  0.0910  0.1100  "ABLA/OSCH-OSCH:LP0"
1283  76231  5  0.0230  0.1020  0.1500  0.0660  0.1150  0.1550  "ABLA/OSCH-OSCH:LP1"
1284  76232  5  0.0190  0.0710  0.1730  0.2640  0.1340  0.1700  "ABLA/OSCH-OSCH:LP2"
1285  76233  5  0.0240  0.0870  0.2160  0.1850  0.1040  0.1220  "ABLA/OSCH-OSCH:LP3"
1286  76241  5  0.0230  0.1020  0.1500  0.1660  0.1150  0.1550  "ABLA/OSCH-OSCH:SF1"
1287  76244  5  0.0250  0.1090  0.2350  0.2300  0.1380  0.1850  "ABLA/OSCH-OSCH:SF"
1288  76252  5  0.0010  0.1100  0.2000  0.1500  0.1120  0.2720  "ABLA/OSCH-OSCH:WB2"
1289  76253  5  0.0010  0.1100  0.0200  0.1500  0.1120  0.2720  "ABLA/OSCH-OSCH:WB3"
1290  76270  1  0.0340  0.0360  0.0001  0.0160  0.0340  0.0001  "ABLA/OSCH-OSCH:ASP0 "
1291  76272  5  0.0040  0.0410  0.0120  0.2230  0.0720  0.1250  "ABLA/OSCH-OSCH:ASP2"
1292  76273  5  0.0040  0.0410  0.0120  0.2230  0.0720  0.1250  "ABLA/OSCH-OSCH:ASP3"
1293  76284  5  0.0050  0.0480  0.1500  0.3880  0.2280  0.0750  "ABLA/OSCH-OSCH:MF"
1294  77022  5  0.0200  0.0500  0.0001  0.1210  0.0670  0.0001  "ABLA/CLPS:DF2"
1295  77023  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/CLPS:DF3"
1296  77024  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/CLPS:DF"
1297  77034  5  0.0660  0.0570  0.0001  0.0680  0.0850  0.0001  "ABLA/CLPS:LP"
1298  77044  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/CLPS:SF"
1299  78020  1  0.0180  0.0420  0.0001  0.0150  0.0540  0.0001  "ABLA/ARCO:DF0"
1300  78021  5  0.0180  0.0420  0.0001  0.1090  0.0540  0.0001  "ABLA/ARCO:DF1"
1301  78022  5  0.0200  0.0500  0.0001  0.1210  0.0670  0.0001  "ABLA/ARCO:DF2"
1302  78023  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/ARCO:DF3"
1303  78024  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/ARCO:DF"
1304  78030  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO:LP0"
1305  78031  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO:LP1"
1306  78032  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO:LP2"
1307  78033  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "ABLA/ARCO:LP3"
1308  78034  5  0.0660  0.0570  0.0001  0.0680  0.0850  0.0001  "ABLA/ARCO:LP"
1309  78040  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO:SF0"
1310  78041  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO:SF1"
1311  78042  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO:SF2"
1312  78044  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/ARCO:SF"
1313  78050  1  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO:WB0"
1314  78051  5  0.0001  0.1380  0.4360  0.0001  0.0880  0.3560  "ABLA/ARCO:WB1"
1315  78052  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/ARCO:WB2"
1316  78053  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO:WB3"
1317  78054  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO:WB"
1318  78063  5  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO:KR"
1319  78070  1  0.0180  0.0420  0.0001  0.0150  0.0540  0.0001  "ABLA/ARCO:ASP0"
1320  78071  5  0.0180  0.0001  0.0001  0.1090  0.0540  0.0001  "ABLA/ARCO:ASP1"
1321  78072  5  0.0260  0.0710  0.0001  0.1130  0.0740  0.0001  "ABLA/ARCO:ASP2"
1322  78073  5  0.0260  0.0710  0.0001  0.1130  0.0740  0.0001  "ABLA/ARCO:ASP3"
1323  78074  5  0.0260  0.0710  0.0001  0.1130  0.0740  0.0001  "ABLA/ARCO:ASP"
```

```
1324  78080  1  0.0180  0.0420  0.0001  0.1090  0.0540  0.0001  "ABLA/ARCO:MF0 (BGD)"
1325  78081  5  0.0180  0.0420  0.0001  0.1090  0.0540  0.0001  "ABLA/ARCO:MF1"
1326  78082  5  0.0200  0.0500  0.0001  0.1210  0.0670  0.0001  "ABLA/ARCO:MF2"
1327  78084  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/ARCO:MF"
1328  78123  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/ARCO-ARCO:DF3"
1329  78130  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-ARCO:LP0"
1330  78131  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO-ARCO:LP1"
1331  78132  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO-ARCO:LP2"
1332  78133  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "ABLA/ARCO-ARCO:LP3"
1333  78140  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-ARCO:SF0"
1334  78141  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO-ARCO:SF1"
1335  78144  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/ARCO-ARCO:SF"
1336  78150  1  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO:WB0"
1337  78151  5  0.0001  0.1380  0.4360  0.0001  0.0880  0.3560  "ABLA/ARCO-ARCO:WB1"
1338  78152  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/ARCO-ARCO:WB2"
1339  78153  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-ARCO:WB3"
1340  78154  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-ARCO:WB"
1341  78163  5  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO-ARCO:KR"
1342  78170  1  0.0180  0.0420  0.0001  0.0150  0.0540  0.0001  "ABLA/ARCO-ARCO:ASP0"
1343  78223  5  0.0220  0.0570  0.0001  0.1320  0.0180  0.0001  "ABLA/ARCO-ASMI:DF3"
1344  78230  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-ASMI:LP0(BGD)"
1345  78232  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO-ASMI:LP2"
1346  78233  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "ABLA/ARCO-ASMI:LP3"
1347  78234  5  0.0660  0.0570  0.0001  0.0680  0.0850  0.0001  "ABLA/ARCO-ASMI:LP"
1348  78240  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-ASMI:SF0(BGD)"
1349  78241  5  0.0990  0.0840  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO-ASMI:SF1"
1350  78244  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/ARCO-ASMI:SF"
1351  78253  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-ASMI:WB3"
1352  78254  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-ASMI:WB"
1353  78322  5  0.0001  0.0500  0.0001  0.1210  0.0670  0.0001  "ABLA/ARCO-SHCA:DF2"
1354  78323  5  0.0220  0.0570  0.0001  0.1320  0.0810  0.0001  "ABLA/ARCO-SHCA:DF3"
1355  78330  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-SHCA:LP0"
1356  78331  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO-SHCA:LP1"
1357  78332  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO-SHCA:LP2"
1358  78333  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "ABLA/ARCO-SHCA:LP3"
1359  78341  5  0.0990  0.1210  0.0001  0.0570  0.0820  0.0001  "ABLA/ARCO-SHCA:SF1"
1360  78344  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/ARCO-SHCA:SF"
1361  78350  1  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO-SHCA:WB"
1362  78352  5  0.0001  0.1380  0.4750  0.0001  0.0840  0.4630  "ABLA/ARCO-SHCA:WB2"
1363  78353  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-SHCA:WB3"
1364  78354  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-SHCA:WB"
1365  78363  5  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO-SHCA:KR"
1366  78373  5  0.0230  0.0710  0.0001  0.1130  0.0740  0.0001  "ABLA/ARCO-SHCA:ASP3"
1367  78430  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-PIEN:LP0 (BGD)"
1368  78432  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "ABLA/ARCO-PIEN:LP2"
1369  78433  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "ABLA/ARCO-PIEN:LP3"
1370  78440  1  0.0510  0.1210  0.0001  0.0160  0.0650  0.0001  "ABLA/ARCO-PIEN:SF0 (BGD)"
1371  78444  5  0.1090  0.1280  0.0001  0.0780  0.0990  0.0001  "ABLA/ARCO-PIEN:SF"
1372  78450  1  0.0001  0.0890  0.2380  0.0001  0.0140  0.1920  "ABLA/ARCO-PIEN:WB0(BGD)"
1373  78453  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-PIEN:WB3"
1374  78454  5  0.0001  0.1370  0.5120  0.0001  0.0790  0.5700  "ABLA/ARCO-PIEN:WB"
```

```
1375 79020 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE:DF0"
1376 79021 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE:DF1"
1377 79022 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.0440 "ABLA/CAGE:DF2"
1378 79023 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE:DF3"
1379 79024 5 0.0370 0.0410 0.0950 0.0450 0.0620 0.1640 "ABLA/CAGE:DF"
1380 79030 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE:LP0"
1381 79031 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE:LP1"
1382 79032 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1440 "ABLA/CAGE:LP2"
1383 79033 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE:LP3"
1384 79034 5 0.0370 0.0410 0.0950 0.0400 0.0620 0.1640 "ABLA/CAGE:LP"
1385 79040 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE:SF0"
1386 79041 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE:SF1"
1387 79042 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1440 "ABLA/CAGE:SF2"
1388 79044 5 0.0620 0.0920 0.1820 0.0450 0.0720 0.1570 "ABLA/CAGE:SF"
1389 79050 1 0.0090 0.0650 0.0960 0.0090 0.0100 0.0780 "ABLA/CAGE:WB0"
1390 79051 5 0.0320 0.1010 0.1770 0.0380 0.0660 0.1440 "ABLA/CAGE:WB1"
1391 79052 5 0.0360 0.1010 0.1930 0.0340 0.0620 0.1870 "ABLA/CAGE:WB2"
1392 79053 5 0.0390 0.1000 0.2080 0.0300 0.0590 0.2300 "ABLA/CAGE:WB3"
1393 79054 5 0.0390 0.1000 0.2080 0.0300 0.0590 0.2300 "ABLA/CAGE:WB"
1394 79063 5 0.0090 0.0650 0.0960 0.0090 0.0100 0.0780 "ABLA/CAGE:KR"
1395 79070 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE:ASP0"
1396 79071 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE:ASP1"
1397 79072 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1440 "ABLA/CAGE:ASP2"
1398 79073 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE:ASP3"
1399 79074 5 0.0370 0.0410 0.0950 0.0400 0.0620 0.1640 "ABLA/CAGE:ASP"
1400 79120 1 0.0290 0.0860 0.1150 0.0001 0.0001 0.0001 "ABLA/CAGE-CAGE:DF0"
1401 79121 5 0.0560 0.0860 0.1160 0.0001 0.0001 0.0001 "ABLA/CAGE-CAGE:DF1"
1402 79122 5 0.0470 0.0600 0.1340 0.0001 0.0001 0.0001 "ABLA/CAGE-CAGE:DF2"
1403 79123 5 0.0610 0.0730 0.1680 0.0001 0.0001 0.0001 "ABLA/CAGE-CAGE:DF3"
1404 79124 5 0.0370 0.0410 0.0950 0.0001 0.0001 0.0001 "ABLA/CAGE-CAGE:DF"
1405 79130 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE-CAGE:LP0"
1406 79131 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE-CAGE:LP1"
1407 79132 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1440 "ABLA/CAGE-CAGE:LP2"
1408 79133 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE-CAGE:LP3"
1409 79134 5 0.0370 0.0410 0.0950 0.0400 0.0620 0.1640 "ABLA/CAGE-CAGE:LP"
1410 79140 1 0.0290 0.0860 0.1150 0.0090 0.0480 0.0940 "ABLA/CAGE-CAGE:SF0"
1411 79141 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE-CAGE:SF1"
1412 79142 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1440 "ABLA/CAGE-CAGE:SF2"
1413 79144 5 0.0620 0.0920 0.1820 0.0450 0.0720 0.1570 "ABLA/CAGE-CAGE:SF"
1414 79150 1 0.0090 0.0650 0.0960 0.0090 0.0100 0.0780 "ABLA/CAGE-CAGE:WB0"
1415 79151 5 0.0320 0.1010 0.1770 0.0380 0.0660 0.1440 "ABLA/CAGE-CAGE:WB1"
1416 79152 5 0.0360 0.1010 0.1930 0.0340 0.0620 0.1870 "ABLA/CAGE-CAGE:WB2"
1417 79153 5 0.0390 0.1000 0.2080 0.0300 0.0590 0.2300 "ABLA/CAGE-CAGE:WB3"
1418 79154 5 0.0390 0.1000 0.2080 0.0300 0.0590 0.2300 "ABLA/CAGE-CAGE:WB"
1419 79163 5 0.0090 0.0650 0.0960 0.0090 0.0100 0.0780 "ABLA/CAGE-CAGE:KR(BGD)"
1420 79170 1 0.0290 0.0860 0.1150 0.0900 0.0480 0.0940 "ABLA/CAGE-CAGE:ASP0"
1421 79171 5 0.0560 0.0860 0.1160 0.0330 0.0600 0.1310 "ABLA/CAGE-CAGE:ASP1"
1422 79172 5 0.0470 0.0600 0.1340 0.0520 0.0700 0.1400 "ABLA/CAGE-CAGE:ASP2"
1423 79173 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE-CAGE:ASP3"
1424 79174 5 0.0370 0.0410 0.0950 0.0400 0.0620 0.1640 "ABLA/CAGE-CAGE:ASP"
1425 79184 5 0.0610 0.0730 0.1680 0.0360 0.0550 0.1040 "ABLA/CAGE-CAGE:MF"
```

```
1426  79220  1  0.0290  0.0860  0.1150  0.0090  0.0480  0.0940  "ABLA/CAGE-PSME:DF0"
1427  79221  5  0.0560  0.0860  0.1160  0.0330  0.0600  0.1310  "ABLA/CAGE-PSME:DF1"
1428  79222  5  0.0470  0.0600  0.1340  0.0520  0.0700  0.1440  "ABLA/CAGE-PSME:DF2"
1429  79223  5  0.0610  0.0730  0.1680  0.0360  0.0550  0.1040  "ABLA/CAGE-PSME:DF3"
1430  79224  5  0.0370  0.0410  0.0950  0.0400  0.0620  0.1640  "ABLA/CAGE-PSME:DF"
1431  79230  1  0.0290  0.0860  0.1150  0.0090  0.0480  0.0940  "ABLA/CAGE-PSME:LP0"
1432  79231  5  0.0560  0.0860  0.1160  0.0330  0.0600  0.1310  "ABLA/CAGE-PSME:LP1"
1433  79232  5  0.0470  0.0600  0.1340  0.0520  0.0700  0.1440  "ABLA/CAGE-PSME:LP2"
1434  79233  5  0.0610  0.0730  0.1680  0.0360  0.0550  0.1040  "ABLA/CAGE-PSME:LP3"
1435  79234  5  0.0370  0.0410  0.0950  0.0400  0.0620  0.1640  "ABLA/CAGE-PSME:LP"
1436  79240  1  0.0290  0.0860  0.1150  0.0090  0.0480  0.0940  "ABLA/CAGE-PSME:SF0"
1437  79241  5  0.0560  0.0860  0.1160  0.0330  0.0660  0.1310  "ABLA/CAGE-PSME:SF1"
1438  79242  5  0.0470  0.0600  0.1340  0.0520  0.0700  0.1440  "ABLA/CAGE-PSME:SF2"
1439  79244  5  0.0620  0.0920  0.1820  0.0450  0.0720  0.1570  "ABLA/CAGE-PSME:SF"
1440  79250  1  0.0090  0.0650  0.0960  0.0090  0.0100  0.0780  "ABLA/CAGE-PSME:WB0"
1441  79251  5  0.0320  0.1010  0.1770  0.0380  0.0660  0.1440  "ABLA/CAGE-PSME:WB1"
1442  79252  5  0.0360  0.1010  0.1930  0.0340  0.0620  0.1870  "ABLA/CAGE-PSME:WB2"
1443  79253  5  0.0390  0.1000  0.2080  0.0300  0.0590  0.2300  "ABLA/CAGE-PSME:WB3"
1444  79254  5  0.0390  0.1000  0.2080  0.0300  0.0590  0.2300  "ABLA/CAGE-PSME:WB"
1445  79270  1  0.0290  0.0860  0.1150  0.0900  0.0480  0.0940  "ABLA/CAGE-PSME:ASP0"
1446  79271  5  0.0560  0.0860  0.1160  0.0330  0.0600  0.1310  "ABLA/CAGE-PSME:ASP1"
1447  79272  5  0.0470  0.0600  0.1340  0.0520  0.0700  0.1400  "ABLA/CAGE-PSME:ASP2"
1448  79273  5  0.0610  0.0730  0.1680  0.0360  0.0550  0.1040  "ABLA/CAGE-PSME:ASP3"
1449  79274  5  0.0370  0.0410  0.0950  0.0400  0.0620  0.1640  "ABLA/CAGE-PSME:ASP"
1450  79530  1  0.0140  0.0430  0.0580  0.0450  0.0240  0.0470  "ABLA/CARO:LP0"
1451  79531  5  0.0282  0.0430  0.0580  0.0170  0.0300  0.0660  "ABLA/CARO:LP1"
1452  79532  5  0.0240  0.0300  0.0670  0.0260  0.0350  0.0700  "ABLA/CARO:LP2"
1453  79533  5  0.0300  0.0360  0.0840  0.0180  0.0280  0.0520  "ABLA/CARO:LP3"
1454  79534  5  0.0180  0.0200  0.0480  0.0200  0.0310  0.0820  "ABLA/CARO:LP4"
1455  79551  5  0.0320  0.1010  0.1770  0.0190  0.0330  0.0720  "ABLA/CARO:WB1 (KRB2)"
1456  79553  5  0.0390  0.1000  0.2080  0.0150  0.0295  0.1150  "ABLA/CARO:WB3 (KRB2)"
1457  79562  5  0.0180  0.0200  0.0480  0.0200  0.0310  0.0820  "ABLA/CARO:LPP"
1458  81023  5  0.0001  0.0170  0.2420  0.0001  0.0320  0.0450  "ABLA/RIMO:DF3"
1459  81030  1  0.0001  0.0230  0.1040  0.0001  0.0290  0.0190  "ABLA/RIMO:LP0"
1460  81031  5  0.0001  0.0230  0.1100  0.0001  0.0350  0.1190  "ABLA/RIMO:LP1"
1461  81032  5  0.0001  0.0100  0.1520  0.0001  0.0400  0.1490  "ABLA/RIMO:LP2"
1462  81033  5  0.0001  0.0170  0.2420  0.0001  0.0320  0.0450  "ABLA/RIMO:LP3"
1463  81034  5  0.0001  0.0170  0.2420  0.0001  0.0320  0.0450  "ABLA/RIMO:LP"
1464  81040  1  0.0001  0.0230  0.1040  0.0001  0.0290  0.0190  "ABLA/RIMO:SF0"
1465  81041  5  0.0001  0.0230  0.1100  0.0001  0.0350  0.1190  "ABLA/RIMO:SF1"
1466  81042  5  0.0001  0.0100  0.1520  0.0001  0.0400  0.1490  "ABLA/RIMO:SF2"
1467  81044  5  0.0001  0.0300  0.3450  0.0001  0.0350  0.3720  "ABLA/RIMO:SF"
1468  81050  1  0.0001  0.0120  0.0550  0.0001  0.0100  0.0480  "ABLA/RIMO:WB0"
1469  81051  5  0.0001  0.0310  0.2660  0.0001  0.0380  0.1490  "ABLA/RIMO:WB1"
1470  81052  5  0.0001  0.0300  0.3040  0.0001  0.0360  0.2570  "ABLA/RIMO:WB2"
1471  81053  5  0.0001  0.0300  0.3450  0.0001  0.0350  0.3720  "ABLA/RIMO:WB3"
1472  81054  5  0.0001  0.0300  0.3450  0.0001  0.0350  0.3720  "ABLA/RIMO:WB"
1473  81114  5  0.0001  0.0170  0.2420  0.0001  0.0320  0.0450  "ABLA/RIMO-RIMO:LI"
1474  81123  5  0.0001  0.0170  0.2420  0.0001  0.0320  0.0450  "ABLA/RIMO-RIMO:DF3"
1475  81140  1  0.0001  0.0230  0.1040  0.0001  0.0290  0.0190  "ABLA/RIMO-RIMO:SF0"
1476  81141  5  0.0001  0.0230  0.1100  0.0001  0.0350  0.1190  "ABLA/RIMO-RIMO:SF1"
```

```
1477 81144 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "ABLA/RIMO-RIMO:SF"
1478 81153 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "ABLA/RIMO-RIMO:WB3"
1479 81163 5 0.0001 0.1200 0.0550 0.0001 0.0100 0.0480 "ABLA/RIMO-RIMO:KR"
1480 81170 1 0.0001 0.0230 0.1040 0.0001 0.0290 0.0190 "ABLA/RIMO-RIMO:ASP0"
1481 81223 5 0.0001 0.0170 0.2420 0.0001 0.0320 0.0450 "ABLA/RIMO-PIAL:DF3"
1482 81232 5 0.0001 0.0100 0.1520 0.0001 0.0400 0.1490 "ABLA/RIMO-PIAL:LP2"
1483 81233 5 0.0001 0.0170 0.2420 0.0001 0.0320 0.0450 "ABLA/RIMO-PIAL;LP3"
1484 81240 1 0.0001 0.0230 0.1040 0.0001 0.0290 0.0190 "ABLA/RIMO-PIAL:SF0"
1485 81241 5 0.0001 0.0230 0.1100 0.0001 0.0350 0.1190 "ABLA/RIMO-PIAL:SF1"
1486 81244 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "ABLA/RIMO-PIAL:SF"
1487 81251 5 0.0001 0.0310 0.2660 0.0001 0.0380 0.1490 "ABLA/RIMO-PIAL:WB1"
1488 81252 5 0.0001 0.0300 0.3040 0.0001 0.0360 0.2570 "ABLA/RIMO-PIAL:WB2"
1489 81253 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "ABLA/RIMO-PIAL:WB3"
1490 81254 5 0.0001 0.0300 0.3450 0.0001 0.0350 0.3720 "ABLA/RIMO-PIAL:WB"
1491 81263 5 0.0001 0.0120 0.0550 0.0001 0.0100 0.0480 "ABLA/RIMO-PIAL:KR"
1492 82023 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "ABLA-PIAL/VASC:DF3"
1493 82030 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA-PIAL/VASC:LP0"
1494 82031 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA-PIAL/VASC:LP1"
1495 82032 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA-PIAL/VASC:LP2"
1496 82033 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "ABLA-PIAL/VASC:LP3"
1497 82034 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "ABLA-PIAL/VASC:LP"
1498 82040 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA-PIAL/VASC:SF0"
1499 82041 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA-PIAL/VASC:SF1"
1500 82042 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "ABLA-PIAL/VASC:SF2"
1501 82044 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA-PIAL/VASC:SF"
1502 82050 1 0.0001 0.0980 0.1560 0.0001 0.0830 0.1290 "ABLA-PIAL/VASC:WB0"
1503 82051 5 0.0001 0.2560 0.7520 0.0001 0.3090 0.3970 "ABLA-PIAL/VASC:WB1"
1504 82052 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "ABLA-PIAL/VASC:WB2"
1505 82053 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA-PIAL/VASC:WB3"
1506 82054 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA-PIAL/VASC:WB"
1507 82084 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "ABLA-PIAL/VASC:MF"
1508 83041 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA/LUHI:SF1"
1509 83114 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/LUHI-VASC:LI"
1510 83140 1 0.0001 0.1930 0.2930 0.0001 0.2370 0.0500 "ABLA/LUHI-VASC:SF0"
1511 83141 5 0.0001 0.1930 0.3120 0.0001 0.2860 0.3170 "ABLA/LUHI-VASC:SF1"
1512 83144 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/LUHI-VASC:SF"
1513 83153 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/LUHI-VASC:WB3"
1514 83244 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "ABLA/LUHI-MEFE:SF"
1515 84052 5 0.0001 0.2540 0.8590 0.0001 0.2970 0.6840 "TSME/LUHI:WB2"
1516 84053 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "TSME/LUHI:WB3"
1517 84253 5 0.0001 0.2510 0.9760 0.0001 0.2860 0.9920 "TSME/LUHI-MEFE:WB3"
1518 85030 1 0.0001 0.0620 0.0680 0.0001 0.0760 0.0120 "PIAL-ABLA:LP0"
1519 85031 5 0.0001 0.0620 0.0720 0.0001 0.0920 0.0700 "PIAL-ABLA:LP1"
1520 85032 5 0.0001 0.0270 0.0990 0.0001 0.1050 0.0970 "PIAL-ABLA:LP2"
1521 85033 5 0.0001 0.0450 0.1580 0.0001 0.0850 0.0290 "PIAL-ABLA:LP3"
1522 85034 5 0.0001 0.0450 0.1580 0.0001 0.0850 0.0290 "PIAL-ABLA:LP"
1523 85040 1 0.0001 0.0620 0.0680 0.0001 0.0760 0.0120 "PIAL-ABLA:SF0"
1524 85041 5 0.0001 0.0620 0.0720 0.0001 0.0920 0.0770 "PIAL-ABLA:SF1"
1525 85042 5 0.0001 0.0270 0.0990 0.0001 0.1050 0.0970 "PIAL-ABLA:SF2"
1526 85044 5 0.0001 0.0810 0.2250 0.0001 0.0920 0.2420 "PIAL-ABLA:SF"
1527 85050 1 0.0001 0.0320 0.0360 0.0001 0.0270 0.0310 "PIAL-ABLA:WB0"
```

```
1528 85051 5 0.0001 0.0830 0.1730 0.0001 0.0990 0.0970 "PIAL-ABLA:WB1"
1529 85052 5 0.0001 0.0820 0.1980 0.0001 0.0960 0.1670 "PIAL-ABLA:WB2"
1530 85053 5 0.0001 0.0810 0.2250 0.0001 0.0920 0.2420 "PIAL-ABLA:WB3"
1531 85054 5 0.0001 0.0810 0.2250 0.0001 0.0920 0.2420 "PIAL-ABLA:WB"
1532 85060 1 0.0001 0.0320 0.0360 0.0001 0.0270 0.0310 "PIAL-ABLA:KRB (BGD)"
1533 85063 5 0.0001 0.0830 0.1730 0.0001 0.0990 0.0970 "PIAL-ABLA:KR"
1534 87023 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "PIAL h.t.:DF3"
1535 87032 5 0.0001 0.0830 0.4290 0.0001 0.3260 0.3970 "PIAL h.t.:LP2"
1536 87034 5 0.0001 0.1400 0.6830 0.0001 0.2630 0.1190 "PIAL h.t.:LP (BGD) ???"
1537 87050 1 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL h.t.:WB0"
1538 87051 5 0.0001 0.2120 0.2490 0.0001 0.2360 0.1860 "PIAL h.t.:WB1"
1539 87052 5 0.0001 0.2140 0.2850 0.0001 0.2410 0.2500 "PIAL h.t.:WB2"
1540 87053 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL h.t.:WB3"
1541 87054 5 0.0001 0.1230 0.3130 0.0001 0.2460 0.3200 "PIAL/h.t.:WB"
1542 87063 5 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL h.t.:KR"
1543 87530 1 0.0001 0.0620 0.0680 0.0001 0.0760 0.0120 "PIAL/VASC:LP0"
1544 87532 5 0.0001 0.0270 0.0770 0.0001 0.1050 0.0970 "PIAL/VASC:LP2"
1545 87533 5 0.0001 0.0450 0.1580 0.0001 0.0850 0.0290 "PIAL/VASC:LP3"
1546 87544 5 0.0001 0.0810 0.2250 0.0001 0.0920 0.2420 "PIAL/VASC:SF"
1547 87550 5 0.0001 0.0320 0.0360 0.0001 0.0410 0.0400 "PIAL/VASC:WB0"
1548 87551 5 0.0001 0.0830 0.1430 0.0001 0.1520 0.1230 "PIAL/VASC:WB1"
1549 87552 5 0.0001 0.0820 0.1980 0.0001 0.1470 0.2120 "PIAL/VASC:WB2"
1550 87553 5 0.0001 0.0810 0.2250 0.0001 0.1410 0.3070 "PIAL/VASC:WB3"
1551 87554 5 0.0001 0.0810 0.2250 0.0001 0.1410 0.3070 "PIAL/VASC:WB"
1552 87560 1 0.0001 0.0320 0.0360 0.0001 0.0410 0.0400 "PIAL/VASC:KRB (BGD)"
1553 87563 5 0.0001 0.0830 0.1730 0.0001 0.1520 0.1230 "PIAL/VASC:KR"
1554 87581 5 0.0001 0.0830 0.1430 0.0001 0.1520 0.1230 "PIAL/VASC:MF1 (BGD)"
1555 88034 5 0.0001 0.0450 0.1580 0.0001 0.0850 0.0290 "PIAL/CAGE:LP (BGD) ???"
1556 88050 1 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL/CAGE:WB0"
1557 88051 5 0.0001 0.2120 0.2490 0.0001 0.2360 0.1860 "PIAL/CAGE:WB1"
1558 88052 5 0.0001 0.2140 0.2850 0.0001 0.2410 0.2500 "PIAL/CAGE:WB2"
1559 88053 5 0.0001 0.2160 0.3840 0.0001 0.2460 0.3200 "PIAL/CAGE:WB3"
1560 88054 5 0.0001 0.0780 0.3290 0.0001 0.0900 0.3400 "PIAL/CAGE:WB"
1561 88530 1 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL/JUCO:LP0"
1562 88531 5 0.0001 0.2120 0.2490 0.0001 0.2360 0.1860 "PIAL/JUCO:LP1"
1563 88532 5 0.0001 0.2140 0.2850 0.0001 0.2410 0.2500 "PIAL/JUCO:LP2"
1564 88533 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO:LP3"
1565 88534 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO:LP"
1566 88540 1 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL/JUCO:SF0"
1567 88541 5 0.0001 0.2120 0.2490 0.0001 0.2360 0.1860 "PIAL/JUCO:SF1"
1568 88542 5 0.0001 0.2140 0.2850 0.0001 0.2410 0.2500 "PIAL/JUCO:SF2"
1569 88544 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO:SF"
1570 88550 1 0.0001 0.0820 0.0520 0.0001 0.0640 0.0480 "PIAL/JUCO:WB0"
1571 88551 5 0.0001 0.2120 0.2490 0.0001 0.2360 0.1860 "PIAL/JUCO:WB1"
1572 88552 5 0.0001 0.2140 0.2850 0.0001 0.2410 0.2500 "PIAL/JUCO:WB2"
1573 88553 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO:WB3"
1574 88554 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO:WB"
1575 88733 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO-JUCO:LP3"
1576 88753 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO-JUCO:WB3"
1577 88754 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO-JUCO:WB"
1578 88784 5 0.0001 0.2160 0.3240 0.0001 0.2460 0.3200 "PIAL/JUCO-JUCO:MF"
```

```
1579 89130 I 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/FEID:LP0"
1580 89131 5 0.3120 0.0320 0.2590 0.2590 0.0360 0.2160 "PIAL/FEID:LP1"
1581 89132 5 0.2780 0.0330 0.3000 0.2650 0.0370 0.2900 "PIAL/FEID:LP2"
1582 89133 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/FEID:LP3"
1583 89134 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/FEID:LP"
1584 89140 1 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/FEID:SF0"
1585 89141 5 0.3120 0.0320 0.2590 0.2590 0.0360 0.2160 "PIAL/FEID:SF1"
1586 89142 5 0.2780 0.0330 0.3000 0.2650 0.0370 0.2900 "PIAL/FEID:SF2"
1587 89144 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/FEID:SF"
1588 89150 1 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/FEID:WB0"
1589 89151 5 0.3120 0.0320 0.2590 0.2590 0.0360 0.2160 "PIAL/FEID:WB1"
1590 89152 5 0.2780 0.0330 0.3000 0.2650 0.0370 0.2900 "PIAL/FEID:WB2"
1591 89153 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/FEID:WB3"
1592 89154 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/FEID:WB"
1593 89533 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:LP3"
1594 89534 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:LP"
1595 89544 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:SF"
1596 89550 1 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/CARO:WB0"
1597 89552 5 0.2780 0.0330 0.3000 0.2650 0.0370 0.2900 "PIAL/CARO:WB2"
1598 89553 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:WB3"
1599 89554 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:WB"
1600 89560 1 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/CARO:KRB (BGD)"
1601 89563 5 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/CARO:KR"
1602 89582 5 0.2480 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO:LP3"
1603 89632 5 0.2780 0.0330 0.3000 0.2650 0.0370 0.2900 "PIAL/CARO-PICO:LP2"
1604 89750 1 0.1930 0.0120 0.0550 0.1050 0.0100 0.0560 "PIAL/CARO-CARO:WB0"
1605 89754 5 0.0001 0.0330 0.3450 0.2700 0.0380 0.3720 "PIAL/CARO-CARO:WB"
1606 90170 1 0.0300 0.1270 0.0001 0.2230 0.0720 0.1250 "ASP/WET:ASP0"
1607 90171 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ASP/WET:ASP1"
1608 90172 5 0.0040 0.0410 0.0120 0.2230 0.0720 0.1250 "ASP/WET:ASP2"
1609 90173 5 0.0060 0.0600 0.1330 0.3350 0.1030 0.0940 "ASP/WET:ASP3"
1610 90174 5 0.0060 0.0600 0.1330 0.3350 0.1030 0.0940 "ASP/WET:ASP"
1611 90270 1 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "ASP/MOIST:ASP0"
1612 90271 5 0.0001 0.0500 0.0660 0.0001 0.0470 0.1120 "ASP/MOIST:ASP1"
1613 90272 5 0.0001 0.0700 0.1160 0.0001 0.0660 0.1600 "ASP/MOIST:ASP2"
1614 90273 5 0.0001 0.0700 0.1160 0.0001 0.0660 0.0600 "ASP/MOIST:ASP3"
1615 90274 5 0.0001 0.0700 0.1160 0.0001 0.0660 0.1600 "ASP/MOIST:ASP"
1616 90370 1 0.0540 0.0360 0.0001 0.0160 0.0340 0.0001 "ASP/DRY:ASP0"
1617 90371 5 0.0540 0.0360 0.0001 0.0520 0.0340 0.0001 "ASP/DRY:ASP1"
1618 90372 5 0.3990 0.0100 0.1400 0.0550 0.0470 0.0001 "ASP/DRY:ASP2"
1619 90373 5 0.3990 0.0100 0.1400 0.0550 0.0470 0.0001 "ASP/DRY:ASP3"
1620 90374 5 0.3990 0.0100 0.1400 0.0550 0.1470 0.0001 "ASP/DRY:ASP"
1621 91020 1 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PICO/PUTR:DF0 "
1622 91021 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PICO/PUTR:DF1 "
1623 91022 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PICO/PUTR:DF2 "
1624 91023 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PICO/PUTR:DF3 "
1625 91024 5 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 "PICO/PUTR:DF "
1626 91030 1 0.0130 0.1340 0.0120 0.1630 0.3270 0.0120 "PICO/PUTR:LP0"
1627 91031 5 0.0250 0.1440 0.0110 0.1880 0.3520 0.0110 "PICO/PUTR:LP1"
1628 91032 5 0.0200 0.1530 0.0100 0.2100 0.3710 0.0100 "PICO/PUTR:LP2"
1629 91033 5 0.0280 0.1090 0.0160 0.1810 0.3670 0.0170 "PICO/PUTR:LP3"
```

```
1630  91034  5  0.0280  0.1090  0.0160  0.1810  0.3670  0.0170  "PICO/PUTR:LP"
1631  91040  1  0.0130  0.1340  0.0120  0.0130  0.1340  0.0120  "PICO/PUTR:SF0 "
1632  91041  5  0.0250  0.1440  0.0110  0.0250  0.1440  0.0110  "PICO/PUTR:SF1 "
1633  91042  5  0.0200  0.1530  0.0100  0.0200  0.1530  0.0100  "PICO/PUTR:SF2 "
1634  91169  5  0.3990  0.0100  0.0140  0.0550  0.0470  0.0001  "COTTONWOOD:CTWD"
1635  91190  1  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:WET    (KRB)"
1636  91191  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:WET    (KRB)"
1637  91192  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:WET    (KRB)"
1638  91193  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:WET    (KRB)"
1639  91194  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:WET    (KRB)"
1640  91290  1  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:MOIST(KRB)"
1641  91291  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:MOIST(KRB)"
1642  91292  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:MOIST(KRB)"
1643  91293  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:MOIST(KRB)"
1644  91294  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:MOIST(KRB)"
1645  91390  1  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:DRY    (KRB)"
1646  91391  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:DRY    (KRB)"
1647  91392  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:DRY    (KRB)"
1648  91393  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:DRY    (KRB)"
1649  91394  5  0.3990  0.0100  0.0140  0.1810  0.3670  0.0001  "COTTONWOOD:DRY    (KRB)"
1650  92033  5  0.0130  0.2070  0.4850  0.0570  0.1840  0.3090  "PICO/VACA:LP3 (BGD)"
1651  92053  5  0.0001  0.2510  0.9760  0.0001  0.2860  0.9920  "PICO/VACA:WB3"
1652  92072  5  0.0030  0.1440  0.2990  0.1030  0.1820  0.2360  "PICO/VACA:ASP2"
1653  93530  1  0.0360  0.3250  0.5460  0.0120  0.1850  0.5240  "PICO/VAGL:LP0"
1654  93531  5  0.0360  0.3250  0.5460  0.0410  0.2340  0.7340  "PICO/VAGL:LP1"
1655  93532  5  0.0590  0.2260  0.6350  0.0650  0.2720  0.8070  "PICO/VAGL:LP2"
1656  93534  5  0.0760  0.2760  0.7940  0.0460  0.2120  0.5810  "PICO/VAGL:LP"
1657  94030  1  0.0600  0.1720  0.1420  0.1960  0.1420  0.1480  "PICO/VASC:LP0"
1658  94031  5  0.1130  0.1850  0.1330  0.2270  0.1540  0.1370  "PICO/VASC:LP1"
1659  94032  5  0.0920  0.1960  0.1230  0.2530  0.1620  0.1270  "PICO/VASC:LP2"
1660  94033  5  0.0001  0.0001  0.0001  0.2180  0.1600  0.2110  "PICO/VASC:LP3"
1661  94034  5  0.1280  0.1400  0.1950  0.2180  0.1600  0.2110  "PICO/VASC:LP"
1662  94040  1  0.0600  0.1720  0.1420  0.0600  0.1720  0.1420  "PICO/VASC:SF0 "
1663  94041  5  0.1130  0.1850  0.1330  0.1130  0.1850  0.1330  "PICO/VASC:SF1 "
1664  94042  5  0.0920  0.1960  0.1230  0.0920  0.1960  0.1230  "PICO/VASC:SF2 "
1665  94070  1  0.0001  0.0001  0.0001  0.1960  0.1420  0.1480  "PICO/VASC:ASP0  (TNF)"
1666  94530  1  0.0001  0.0430  0.1150  0.0001  0.0240  0.0940  "PICO/SPBE:LP0"
1667  94531  5  0.0001  0.0430  0.1160  0.0001  0.0300  0.1310  "PICO/SPBE:LP1"
1668  94532  5  0.0001  0.0300  0.1340  0.0001  0.0350  0.1440  "PICO/SPBE:LP2"
1669  94541  5  0.0001  0.0430  0.1160  0.0001  0.0300  0.1310  "PICO/SPBE:SF1"
1670  94570  1  0.0001  0.0008  0.0140  0.0001  0.0050  0.0260  "PICO/SPBE:ASP0"
1671  95030  1  0.0220  0.1340  0.0001  0.0450  0.1100  0.0001  "PICO/CARU:LP0"
1672  95031  5  0.0400  0.1440  0.0001  0.0520  0.1190  0.0001  "PICO/CARU:LP1"
1673  95032  5  0.0330  0.1530  0.0001  0.0580  0.1250  0.0001  "PICO/CARU:LP2"
1674  95033  5  0.0001  0.0001  0.0001  0.0500  0.1240  0.0001  "PICO/CARU:LP3"
1675  95034  5  0.0460  0.1090  0.0001  0.0500  0.1240  0.0001  "PICO/CARU:LP"
1676  95040  1  0.0220  0.1340  0.0001  0.0220  0.1340  0.0001  "PICO/CARU:SFO "
1677  95041  5  0.0400  0.1440  0.0001  0.0400  0.1440  0.0001  "PICO/CARU:SF1 "
1678  95042  5  0.0330  0.1530  0.0001  0.0330  0.1530  0.0001  "PICO/CARU:SF2 "
1679  95044  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CARU:SF "
1680  95070  1  0.0001  0.0530  0.0001  0.0001  0.0600  0.0001  "PICO/CARU:ASP0"
```

```
1681  95071  5  0.0001  0.0150  0.0001  0.0001  0.0600  0.0001  "PICO/CARU:ASP1"
1682  95072  5  0.0001  0.0150  0.0001  0.0001  0.0600  0.0001  "PICO/CARU:ASP2"
1683  95073  5  0.0001  0.0310  0.0001  0.0001  0.0600  0.0001  "PICO/CARU:ASP3"
1684  95074  5  0.0001  0.0310  0.0001  0.0001  0.0780  0.0001  "PICO/CARU:ASP"
1685  95530  1  0.0010  0.1800  0.2990  0.0770  0.2300  0.2790  "PICO/CAGE:LP0"
1686  95531  5  0.0020  0.1930  0.2790  0.0890  0.2490  0.2590  "PICO/CAGE:LP1"
1687  95532  5  0.0010  0.2040  0.2580  0.1000  0.2620  0.2390  "PICO/CAGE:LP2"
1688  95533  5  0.0001  0.0001  0.0001  0.0860  0.2590  0.3980  "PICO/CAGE:LP3"
1689  95534  5  0.0020  0.1460  0.4100  0.0860  0.2590  0.3980  "PICO/CAGE:LP"
1690  95540  1  0.0010  0.1800  0.2990  0.0010  0.1800  0.2990  "PICO/CAGE:SF0 "
1691  95541  5  0.0020  0.1930  0.2790  0.0020  0.1930  0.2790  "PICO/CAGE:SF1 "
1692  95542  5  0.0010  0.2040  0.2580  0.0010  0.2040  0.2580  "PICO/CAGE:SF2 "
1693  95550  1  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CAGE:WB0 "
1694  95551  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CAGE:WB1 "
1695  95552  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CAGE:WB2 "
1696  95553  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CAGE:WB3 "
1697  95554  5  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "PICO/CAGE:WB "
1698  96031  5  0.0001  0.1180  0.3000  0.0001  0.0810  0.3380  "PICO/JUCO:LP1"
1699  96032  5  0.0001  0.1180  0.3000  0.0001  0.0940  0.3720  "PICO/JUCO:LP2 (KRB2)"
1700  96532  5  0.0830  0.0840  0.0001  0.0900  0.0960  0.0001  "PICO/ARCO:LP2"
1701  96533  5  0.1070  0.1020  0.0001  0.0630  0.0750  0.0001  "PICO/ARCO:LP3"
1702  97024  5  0.0180  0.0200  0.0480  0.0200  0.0310  0.0820  "PICO/CARO:DF"
1703  97030  1  0.0140  0.0430  0.0580  0.0450  0.0240  0.0470  "PICO/CARO:LP0"
1704  97031  5  0.0280  0.0430  0.0580  0.0170  0.0300  0.0660  "PICO/CARO:LP1"
1705  97032  5  0.0240  0.0300  0.0670  0.0260  0.0350  0.0700  "PICO/CARO:LP2"
1706  97033  5  0.0300  0.0360  0.0840  0.0180  0.0280  0.0520  "PICO/CARO:LP3"
1707  97034  5  0.0180  0.0200  0.0480  0.0200  0.0310  0.0820  "PICO/CARO:LP"
1708  99070  1  0.0001  0.0500  0.0660  0.0001  0.0470  0.1120  "ASP/MOIST:ASP0 (TNF)"
1709  99071  5  0.0001  0.0500  0.0660  0.0001  0.0470  0.1120  "ASP/MOIST:ASP1 (TNF)"
1710  99072  5  0.0001  0.0700  0.1160  0.0001  0.0660  0.1600  "ASP/MOIST:ASP2 (TNF)"
1711  99073  5  0.0001  0.0700  0.1160  0.0001  0.0660  0.0600  "ASP/MOIST:ASP3 (TNF)"
1712  99074  5  0.0001  0.0700  0.1160  0.0001  0.0660  0.1600  "ASP/MOIST:ASP4 (TNF)"
1713  99999  1  0.0001  0.0001  0.0001  0.0001  0.0001  0.0001  "NODATA/ERROR   (KRB)"
1714  08061  5  0.0001  0.0930  0.0001  0.0001  0.1080  0.0001  "PIFL/HEKI:KR (BGD)"
1715  08062  5  0.0001  0.0930  0.0001  0.0001  0.1080  0.0001  "PIFL/HEKI:KR (BGD)"
```

EDGE COEFFICIENTS

NonForest Types				Forest Types		
---With Ungulates---				---Without Ungulates---		
Spring	Summer	Fall		Spring	Summer	Fall
17.5	12.5	6.0		21.2	15.4	8.3

SUPPLEMENTAL HABITAT COEFFICIENTS

```
########################################################################
#Type ICE9 Supplement Parameters
#Desc GYE Standard Supplement Classes (Jan 09, 1997)
########################################################################
#
#   Supplemental Habitat Class File
#   Greater Yellowstone Ecosystem
#   Last modified on Jan 9, 1997 by Collin D. Bevins
#
########################################################################
```

Code	Coefficient	Season Applied	Description
MW	1.00	0301-0531	Moose Winter Range
BW	1.00	0301-0531	Bison Winter Range
ET	1.90	0301-0531	Geothermal Elk Winter Range
EH	1.60	0301-0531	High Elevation Elk Winter Range
EL	1.00	0301-0531	Low Elevation Elk Winter Range
US	1.50	0601-1130	Ungulate Summer/Fall Range
UC	1.50	0301-0831	Ungulate Calving Grounds
CC	1.60	0301-0531	Carrion Concentration Areas
FS	2.50	0501-0715	Fish Spawning Stream
MO	19.20	0701-0831	Moth Aggregation Sites

WHERE MORE THAN ONE TYPE OCCURS IN A POLYGON, THE HIGHEST
VALUE FOR THAT SEASON IS APPLIED.

DISTURBANCE·COEFFICIENTS

```
################################################################################
#   Activity Class File
#   Greater Yellowstone Ecosystem
#   Last modified on Jan 9, 1997 by Collin D. Bevins
################################################################################
#       Created on June 14, 1996 by Collin D. Bevins.
#       Modified on August 9, 1996 to reflect new cover type codes:
#               DC1 = Disturbance Coefficient Removed Cover
#               DC2 = Disturbance Coefficient Low·Cover
#               DC3 = Disturbance Coefficient Low/High Cover (mosaic)
#               DC4 = Disturbance Coefficient High/Low Cover (mosaic)
#               DC5 = Disturbance Coefficient High Cover
################################################################################
#   Coefficients range from 0 (total displacement) to 1 (no displacement).
#    ZOI in meters
#
```

Code	ZOI	DC1	DC2	DC3	DC4	DC5	Description
AIRCRAFT	0	0.42	0.42	0.61	0.61	0.79	Aircraft
DEVELOP	0	0.20	0.20	0.28	0.28	0.35	Major Development
D_M_H	0	0.13	0.13	0.31	0.31	0.48	Dispersed Motorized High Use
D_M_L	0	0.66	0.66	0.75	0.75	0.84	Dispersed Motorized Low Use
D_NM_H	0	0.92	0.92	0.95	0.95	0.98	Dispersed Non-motorized High Use
D_NM_L	0	0.97	0.97	0.98	0.98	0.99	Dispersed Non-Motorized Low Use
EXPLOSIVE	0	0.15	0.15	0.33	0.33	0.50	Explosives
L_M_H	805	0.16	0.16	0.37	0.37	0.58	Linear Motorized High Use
L_M_L	805	0.64	0.64	0.73	0.73	0.81	Linear Motorized Low Use
L_M_I	805	0.84	0.84	0.89	0.89	0.93	Linear Motorized Incidental Use
L_NM_H	403	0.56	0.56	0.65	0.65	0.74	Linear Non-motorized High Use
L_NM_L	403	0.83	0.83	0.88	0.88	0.92	Linear Non-motorized Low Use
P_M_24	805	0.10	0.10	0.24	0.24	0.38	Point Motorized 24-hour Use
P_M_H	805	0.16	0.16	0.37	0.37	0.58	Point Motorized Diurnal High Use
P_M_L	805	0.64	0.64	0.73	0.73	0.81	Point Motorized Diurnal Low Use
P_NM_24	403	0.33	0.33	0.50	0.50	0.66	Point Non-motorized 24-hour Use
P_NM_D	403	0.60	0.60	0.70	0.70	0.80	Point Non-motorized Diurnal Use

APPENDIX C

MODEL OUTPUT

ICE9 CEM NUMERIC OUTPUT FILE
(Figures in Habitat Unit Days HUD)

```
MADISON_BMU PRE_V MADISON_BMU 52544 262720 0301 1130 275 11186528.1651 48923778.2667 48923778.2667
MADISON_BMU PRE_V MADISON_BMU 52544 262720 0301 0531 92 2115638.8277 13568469.3618 13568469.3618
MADISON_BMU PRE_V MADISON_BMU 52544 262720 0601 0831 92 4409825.1309 20315031.7263 20315031.7263
MADISON_BMU PRE_V MADISON_BMU 52544 262720 0901 1130 91 4661064.2065 15040277.1785 15040277.1785
MADISON_BMU PRE_V MADISON_#1 32443 162215 0301 1130 275 6578975.5986 37966688.4276 37966688.4276
MADISON_BMU PRE_V MADISON_#1 32443 162215 0301 0531 92 1034915.5046 9574769.0781 9574769.0781
MADISON_BMU PRE_V MADISON_#1 32443 162215 0601 0831 92 2256032.2406 15313456.1062 15313456.1062
MADISON_BMU PRE_V MADISON_#1 32443 162215 0901 1130 91 3288027.8535 13078463.2433 13078463.2433
MADISON_BMU PRE_V MADISON_#2 20101 100505 0301 1130 275 4607552.5664 10957089.8391 10957089.8391
MADISON_BMU PRE_V MADISON_#2 20101 100505 0301 0531 92 1080723.3231 3993700.2837 3993700.2837
MADISON_BMU PRE_V MADISON_#2 20101 100505 0601 0831 92 2153792.8903 5001575.6201 5001575.6201
MADISON_BMU PRE_V MADISON_#2 20101 100505 0901 1130 91 1373036.3530 1961813.9353 1961813.9353
MADISON_BMU PRE_V GNF/MADISON_#1 20137 100685 0301 1130 275 4096031.3741 31690135.1275 31690135.1275
MADISON_BMU PRE_V GNF/MADISON_#1 20137 100685 0301 0531 92 644269.9346 7703302.6526 7703302.6526
MADISON_BMU PRE_V GNF/MADISON_#1 20137 100685 0601 0831 92 1394500.9940 13195726.2269 13195726.2269
MADISON_BMU PRE_V GNF/MADISON_#1 20137 100685 0901 1130 91 2057260.4455 10791106.2480 10791106.2480
MADISON_BMU PRE_V GNF/MADISON_#2 7065 35325 0301 1130 275 1392739.9676 5610706.5232 5610706.5232
MADISON_BMU PRE_V GNF/MADISON_#2 7065 35325 0301 0531 92 479468.7706 2491094.2882 2491094.2882
MADISON_BMU PRE_V GNF/MADISON_#2 7065 35325 0601 0831 92 807655.2580 2830944.8241 2830944.8241
MADISON_BMU PRE_V GNF/MADISON_#2 7065 35325 0901 1130 91 105615.9390 288667.4109 288667.4109
MADISON_BMU PRE_V YNP/MADISON_#1 12306 61530 0301 1130 275 2482944.2246 6276553.3001 6276553.3001
MADISON_BMU PRE_V YNP/MADISON_#1 12306 61530 0301 0531 92 390645.5700 1871466.4255 1871466.4255
MADISON_BMU PRE_V YNP/MADISON_#1 12306 61530 0601 0831 92 861531.2466 2117729.8793 2117729.8793
MADISON_BMU PRE_V YNP/MADISON_#1 12306 61530 0901 1130 91 1230767.4080 2287356.9953 2287356.9953
MADISON_BMU PRE_V YNP/MADISON_#2 13036 65180 0301 1130 275 3214812.5989 5346383.3159 5346383.3159
MADISON_BMU PRE_V YNP/MADISON_#2 13036 65180 0301 0531 92 601254.5526 1502605.9955 1502605.9955
MADISON_BMU PRE_V YNP/MADISON_#2 13036 65180 0601 0831 92 1346137.6323 2170630.7960 2170630.7960
MADISON_BMU PRE_V YNP/MADISON_#2 13036 65180 0901 1130 91 1267420.4140 1673146.5244 1673146.5244
MADISON_BMU PRE_V Gallatin_NF 27177 135885 0301 1130 275 5484720.3557 37283705.0368 37283705.0368
MADISON_BMU PRE_V Gallatin_NF 27177 135885 0301 0531 92 1122476.6491 10188597.7714 10188597.7714
MADISON_BMU PRE_V Gallatin_NF 27177 135885 0601 0831 92 2200828.0086 16018518.3791 16018518.3791
MADISON_BMU PRE_V Gallatin_NF 27177 135885 0901 1130 91 2161415.6980 11076588.8863 11076588.8863
MADISON_BMU PRE_V Yellowstone_NP 25364 126820 0301 1130 275 5701224.5684 11639489.9889 11639489.9889
MADISON_BMU PRE_V Yellowstone_NP 25364 126820 0301 0531 92 993162.0406 3379871.4524 3379871.4524
MADISON_BMU PRE_V Yellowstone_NP 25364 126820 0601 0831 92 2208865.4703 4296381.6953 4296381.6953
MADISON_BMU PRE_V Yellowstone_NP 25364 126820 0901 1130 91 2499197.0575 3963236.8412 3963236.8412
MADISON_BMU PRE_V BEAR101 17999 89995 0301 1130 275 3889994.9747 13572053.5964 13572053.5964
MADISON_BMU PRE_V BEAR101 17999 89995 0301 0531 92 838050.2049 4693097.6119 4693097.6119
MADISON_BMU PRE_V BEAR101 17999 89995 0601 0831 92 1498121.3169 5216915.6869 5216915.6869
MADISON_BMU PRE_V BEAR101 17999 89995 0901 1130 91 1553823.4530 3662040.2975 3662040.2975
MADISON_BMU PRE_V BEAR102 20113 100565 0301 1130 275 4320265.4606 17662792.9164 17662792.9164
MADISON_BMU PRE_V BEAR102 20113 100565 0301 0531 92 1082053.6037 6479658.4880 6479658.4880
MADISON_BMU PRE_V BEAR102 20113 100565 0601 0831 92 1838399.4169 7347978.1951 7347978.1951
MADISON_BMU PRE_V BEAR102 20113 100565 0901 1130 91 1399812.4400 3835156.2334 3835156.2334
MADISON_BMU PRE_V BEAR141 20265 101325 0301 1130 275 4326946.8770 14890790.0461 14890790.0461
MADISON_BMU PRE_V BEAR141 20265 101325 0301 0531 92 673829.9946 3954000.1625 3954000.1625
MADISON_BMU PRE_V BEAR141 20265 101325 0601 0831 92 1520436.4754 5554217.3090 5554217.3090
MADISON_BMU PRE_V BEAR141 20265 101325 0901 1130 91 2132680.4070 5382572.5746 5382572.5746
MADISON_BMU PRE_V BEAR143 227 1135 0301 1130 275 52382.0831 407404.6589 407404.6589
MADISON_BMU PRE_V BEAR143 227 1135 0301 0531 92 1657.6889 35025.2944 35025.2944
MADISON_BMU PRE_V BEAR143 227 1135 0601 0831 92 16088.5657 157072.3590 157072.3590
MADISON_BMU PRE_V BEAR143 227 1135 0901 1130 91 34635.8285 215307.0055 215307.0055
MADISON_BMU PRE_V BEAR16 17394 86970 0301 1130 275 4114159.2630 10429715.1763 10429715.1763
MADISON_BMU PRE_V BEAR16 17394 86970 0301 0531 92 1135637.1834 4193559.4770 4193559.4770
MADISON_BMU PRE_V BEAR16 17394 86970 0601 0831 92 2058554.6546 4902833.8536 4902833.8536
MADISON_BMU PRE_V BEAR16 17394 86970 0901 1130 91 919967.4250 1333321.8457 1333321.8457
MADISON_BMU PRE_V BEAR191 11201 56005 0301 1130 275 2493102.6584 13895525.9884 13895525.9884
MADISON_BMU PRE_V BEAR191 11201 56005 0301 0531 92 272549.4151 2736453.2953 2736453.2953
MADISON_BMU PRE_V BEAR191 11201 56005 0601 0831 92 809348.0777 5617838.5408 5617838.5408
MADISON_BMU PRE_V BEAR191 11201 56005 0901 1130 91 1411205.1655 5541234.1524 5541234.1524
MADISON_BMU PRE_V BEAR200 1628 8140 0301 1130 275 370009.8040 2795813.2030 2795813.2030
MADISON_BMU PRE_V BEAR200 1628 8140 0301 0531 92 35855.8894 551370.9375 551370.9375
MADISON_BMU PRE_V BEAR200 1628 8140 0601 0831 92 121235.8586 1184981.4209 1184981.4209
MADISON_BMU PRE_V BEAR200 1628 8140 0901 1130 91 212918.0560 1059460.8447 1059460.8447
```

ICE9 NUMERIC OUTPUT
(Figures normalized to per acre per day)

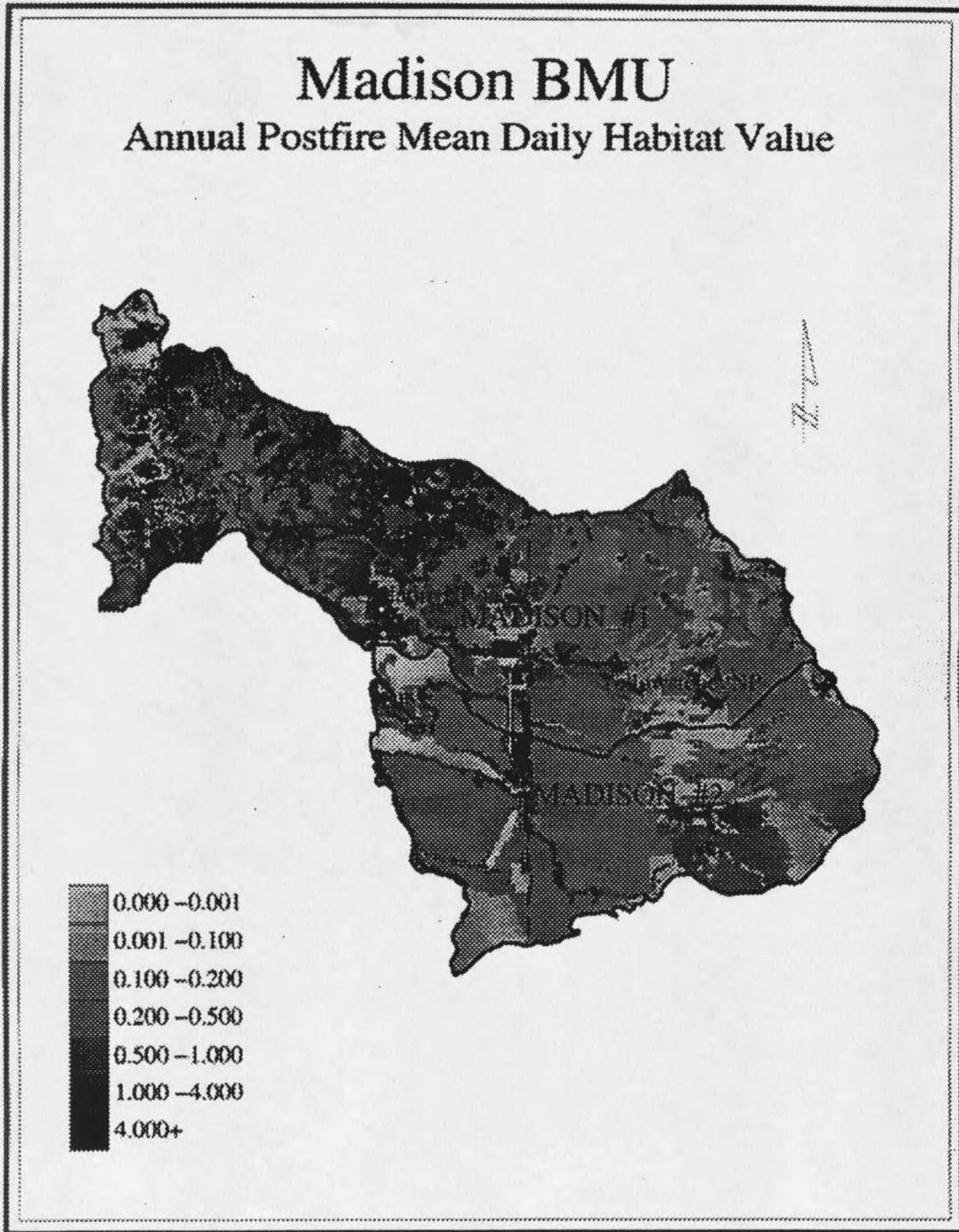MADISON_BMU Bear Management Unit
52544 cells, 262720 acres

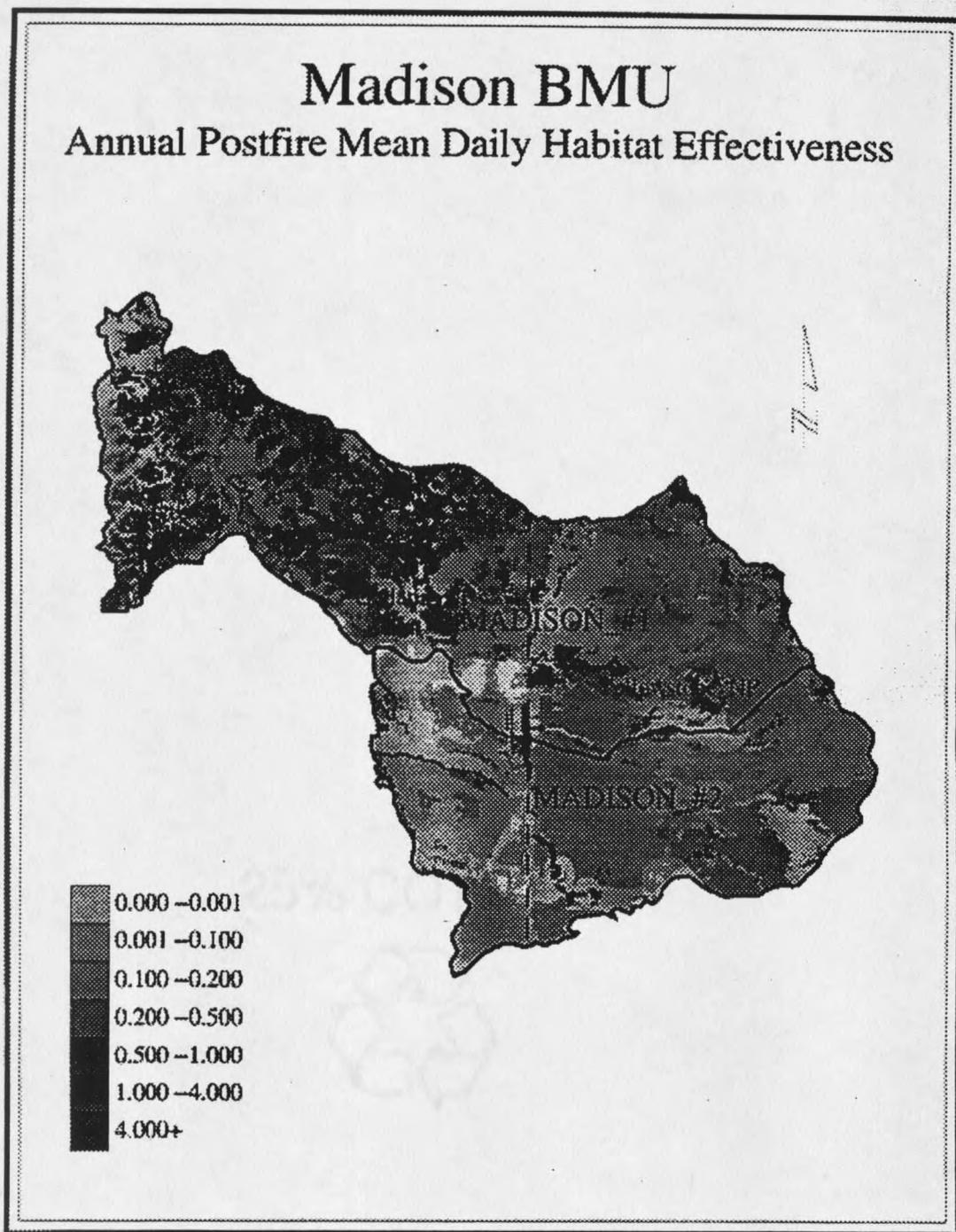Habitat Value & Effectiveness for 6 CEM Alternatives
Each alternative has two rows of 4 seasonal values.
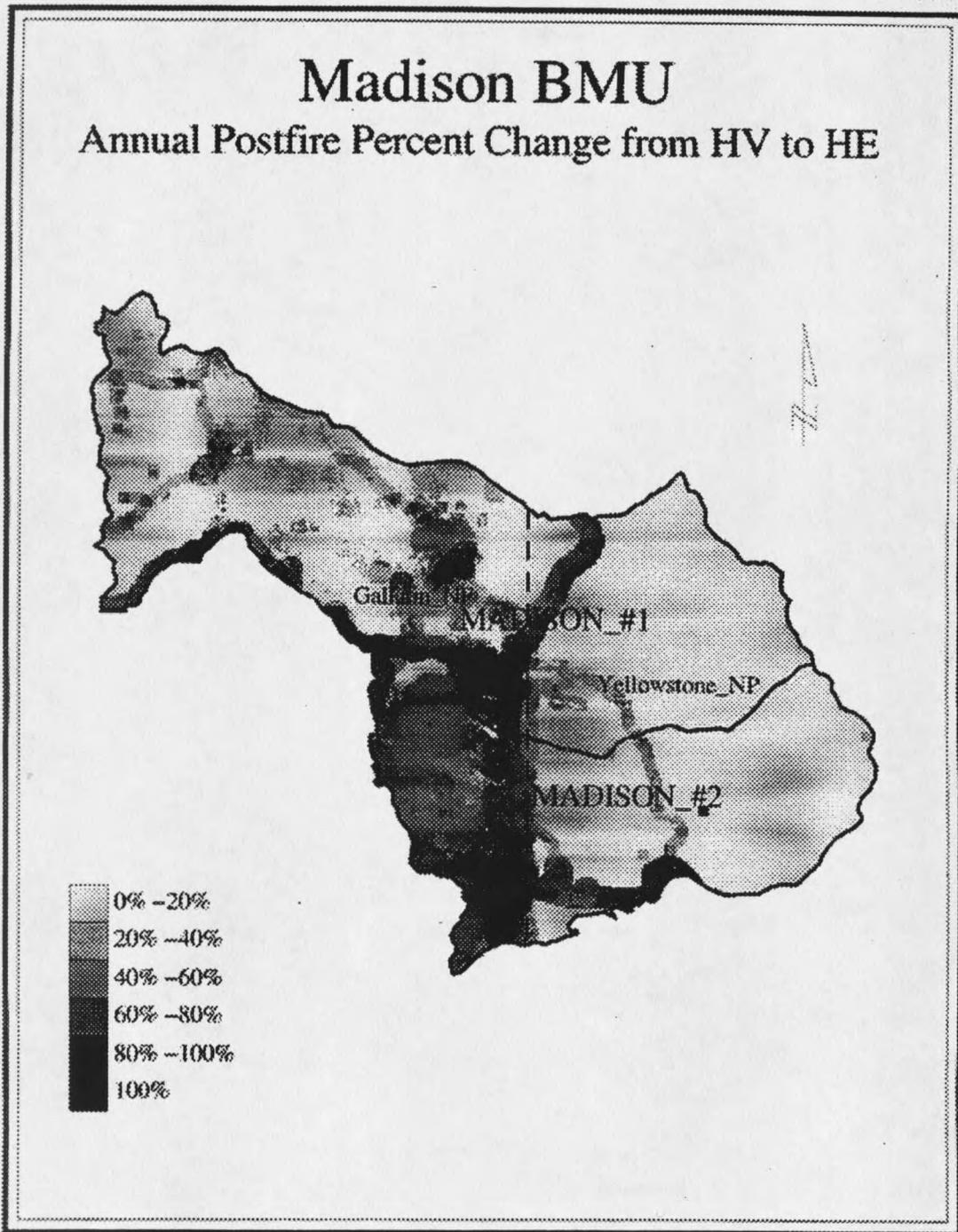The first row is the mean daily per acre seasonal HV and HE.
The second row is the percent change from the previous alternative.

Alternati	0301 Thru 1130 Hab Val	Hab Eff	0301 Thru 0531 Hab Val	Hab Eff	0601 Thru 0831 Hab Val	Hab Eff	0901 Thru 1130 Hab Val	Hab Eff
PRE_V	0.6772	0.6772	0.5614	0.5614	0.8405	0.8405	0.6291	0.6291
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PST_V	0.6643	0.6643	0.5456	0.5456	0.8289	0.8289	0.6179	0.6179
	-1.9	-1.9	-2.8	-2.8	-1.4	-1.4	-1.8	-1.8
PST_VS	0.6995	0.6995	0.5969	0.5969	0.8581	0.8581	0.6429	0.6429
	5.3	5.3	9.4	9.4	3.5	3.5	4.1	4.1
PST_VSL	0.6995	0.4971	0.5969	0.3876	0.8581	0.5952	0.6429	0.5086
	0.0	-28.9	0.0	-35.1	0.0	-30.6	0.0	-20.9
PST_VSLP	0.6995	0.4907	0.5969	0.3848	0.8581	0.5858	0.6429	0.5014
	0.0	-1.3	0.0	-0.7	0.0	-1.6	0.0	-1.4
PST_VSLPD	0.6995	0.4878	0.5969	0.3795	0.8581	0.5852	0.6429	0.4988
	0.0	-0.6	0.0	-1.4	0.0	-0.1	0.0	-0.5

ICE9 GRAPHIC OUTPUT
(Habitat Value Map)

Madison BMU
Annual Postfire Mean Daily Habitat Value

0.000 – 0.001
0.001 – 0.100
0.100 – 0.200
0.200 – 0.500
0.500 – 1.000
1.000 – 4.000
4.000+

1996 Systems for Environmental Management, Missoula, MT

ICE9 GRAPHIC OUTPUT
(Habitat Effectiveness Map)

Madison BMU
Annual Postfire Mean Daily Habitat Effectiveness

Legend:

- 0.000 – 0.001
- 0.001 – 0.100
- 0.100 – 0.200
- 0.200 – 0.500
- 0.500 – 1.000
- 1.000 – 4.000
- 4.000+

1996 Systems for Environmental Management, Missoula, MT

Madison BMU
Annual Postfire Percent Change from HV to HE

Gallatin_NP

MADISON_#1

Yellowstone_NP

MADISON_#2

0% –20%
20% –40%
40% –60%
60% –80%
80% –100%
100%

1996 Systems for Environmental Management, Missoula, MT