Empirical evidence exists to support the utility of Linkages and corridors. In a study by Beier (1995), radio-tagged mountain lions never crossed into urban areas; individuals used defined movement corridors for dispersal and for traveling between areas comprising their home ranges. Beier and Noss's (1998) review of thirty-two empirical studies pertaining to the utility of wildlife corridors supported the idea that corridors are "valuable conservation tools." Price *et al.* (1994) also encourage the consideration of connectedness, particularly for endangered species such as the Stephens' kangaroo rat. Habitat connections are particularly important to the persistence of metapopulations which comprise this species' populations.

Using the available data, the five tenets listed at the beginning of this section were incorporated in the conservation planning process. The species list developed early in the planning process, as described in *Section 2.1.4* of this document, along with the species occurrence database and input provided by local biologists and the information assembled for the species accounts (presented in *Section B* of the MSHCP Reference Document – *Volume II of the MSHCP Plan*), provided guidance for the overall species needs that would need to be met within the conserved areas. The MSHCP vegetation map, coastal sage scrub quality model, and edge analysis were combined and used in a variety of ways to identify the presence and locations of existing large Habitat blocks for potential inclusion within conserved areas. These data and analyses also were used to evaluate existing and potential locations for Habitat Linkages. Data were generally analyzed by plotting hard copy maps of data layers and using acetate overlays to assess combined layers. This overlay technique was also conducted digitally using ArcView.

3.1.5 Review of Reserve Selection Models and Methods

In the spring of 1999 DUDEK reviewed several documents and papers from the "gray" and published scientific literature regarding theoretical and applied reserve selection techniques, ranging from relatively subjective ranking approaches (*e.g.,* Duever and Noss 1990; *San Diego Multiple Species Conservation Program [MSCP] and North San Diego County Multiple Habitat Conservation Program [MHCP])* to highly automated reserve selection approaches (*e.g.,* Church *et al.* 1996). Based on this selective review of the literature, it was determined that these reserve selection procedures held little promise for *a priori* reserve design in the MSHCP planning effort for several reasons: (1) the lack of necessary data to run most of the models; (2) the lack of time and resources to collect such data; (3) the lack of time and resources to validate the results of the models; and (4) the scale differences for the MSHCP Plan Area (highly parcelized) compared to typical scales of 1/4 sections (160 acres) and sections (640 acres) used in the scientific models. Nonetheless, it is instructive to review some of the reserve selection approaches described in the literature because they illustrate many of the important concepts of conservation biology theory and provide some useful analytic approaches for evaluating the MSHCP.

There are many examples of reserve selection procedures in the literature, ranging from quantitative rankings of alternative reserve areas (Duever and Noss 1990) to automated computer algorithms that select reserve units based on pre-programmed criteria (*e.g.,* Austin and Margules 1986; Bedward *et al.* 1992; Church *et al.* 1996; Kirkpatrick 1983; Lomolino 1994; Margules *et al.* 1988; Margules and Usher 1981; Rossi and Kuitunen 1996; Sætersdal and Birks 1993). The computer algorithms typically are designed to select the most efficient reserve system based on some preselected conservation currency such as the maximum number of species, rarity, or biodiversity hotspots; *i.e.,* what reserve design provides the greatest conservation value with the least number of reserve sites? These reserve selection algorithms typically are optimizing solutions such as the Maximal Covering Location Problem (MLCP) (Church *et al.* 1996) or more simple heuristic iterative algorithms that find reasonable approximations to optimum solutions (*e.g.,*Margules *et al.* 1988).

A common feature of the reserve selection approaches is to establish conservation criteria, currency, or surrogates for conservation value. For example, Margules and Usher (1981) identified 18 classes of criteria for evaluating conservation value that could be incorporated into the selection procedure. Some common, but not necessarily mutually exclusive, criteria in these reserve selection models include the following:

- biological diversity (defined in various ways)
- size of reserve unit
- species richness or population abundance
- representativeness (biological and/or environmental)
- complementarity
- irreplaceability
- number of endangered or threatened species
- rarity of species
- naturalness
- threats
- costs
- management requirements

Among these criteria, diversity, rarity, naturalness, size and representativeness are most widely used (Margules *et al.* 1988). Although these criteria tend to be common to selection approaches, how they are defined and used varies among the different model approaches (*e.g.,* Belbin 1993).

As described above, a basic goal of the reserve selection models is to select a set of reserve units that optimizes or maximizes the representation of the identified conservation currency with the least number of units (*e.g.,* Camm *et al.* 1996; Church *et al.* 1996). Criteria can be systematically and interactively manipulated to compare results using different priorities, assumptions, weightings of criteria, etc. A strength of such modeling is flexibility and the ability to evaluate different approaches fairly quickly, depending on the computer resources available, number of variables in the selection model, and the size of the data set. The disadvantage of this flexibility is that there are almost infinite ways that models can be programmed with regard to criteria, assumptions, and weightings. Thus, with a large and diverse group of stakeholders, achieving consensus on the most appropriate approach is extremely difficult. Also, demonstrating the sensitivity, reliability, and external validity of any given approach would be difficult in the planning time frame. The validity of the approach can only be evaluated in terms of the viability of the reserve system. Ultimately a functional analysis of the reserve system will occur over the next several decades through the monitoring and Adaptive Management Program.

An illustration of a reserve selection application is a study by Church *et al.* (1996) where reserve selection is approached as a Maximal Covering Location Problem (MCLP). The MCLP finds the optimum reserve design that solves the problem of selecting "the smallest number of sites from some biological domain which represents all, or as many as possible, of the species in that domain." Using the MCLP has a number of practical problems. A key assumption of the MCLP is that the reserve selected is large enough to support a viable population of a species, community, or Habitat, thus begging the question of what constitutes a viable species, community, or Habitat. This problem would have to be resolved before the reserve selection model could be applied because the viability threshold is part of the computer algorithm. Furthermore, the exercise of evaluating species viability is itself a spatial problem (*e.g.,* how is a viable metapopulation spatially structured), and not just specifying a certain number of populations without regard to their spatial context. Hence, application of the MCLP after this is done seems somewhat redundant, although this qualitative analysis does not address the optimality of design. Finally, it should be noted that Church *et al.* caution that some optimality problems may be difficult or unsolvable. As the number of variables and data set increases, it is less likely that an optimum solution exists or that it can be easily solved.

Given the uncertain application of reserve selection techniques and the broad range of additional issues that would be triggered from such approaches, DUDEK tends to agree with the assertion of Prendergast *et al.* (1999) that funds should be allocated for more pragmatic and policy-driven approaches to Conservation (*i.e.,* what are the jurisdictions actually capable of doing) rather than theoretical optimization of reserve design. Regardless of the reserve design selected, and whether it is algorithm-based or stakeholder-driven, the soundness of the MSHCP Conservation Area has to be evaluated by the Wildlife Agencies and other stakeholders.

Although specific reserve selection models were not developed and used for the reasons noted above, the concepts incorporated in the models and listed above (*e.g.,* diversity, size, representativeness, etc.) were considered in the conservation planning process. Values and goals for the conservation planning effort were identified as described in *Section 3.1.2* of this document. A comprehensive database was assembled as described in *Section 3.1.3* and conservation biology principles were considered as described in *Section 3.1.4.* Based on this framework, an initial Conservation scenario was developed for review by stakeholders with initial identification of potential acreage requirements. Development of this information was necessary for stakeholders to make decisions regarding the next steps in the conservation planning process. Subsequently, as described in *Section 3.1.7,* alternative conservation scenarios were developed for review by stakeholders and a recommended conservation scenario was selected. The recommended conservation scenario was then refined and analyzed as described in *Sections 3.1.8* and *3.2* of this document.

3.1.6 Conceptual Conservation Scenario

An initial reserve concept was developed to assist the MSHCP Advisory Committee in decisions to proceed with conservation planning efforts. This generalized Conceptual Conservation Scenario was developed based on the existing data and literature, habitat assessment workshops, species occurrence information, coastal sage scrub habitat quality modeling, existing and planned land uses, and general conservation biology principles summarized in the NCCP reserve design tenets. At the direction of the MSHCP Advisory Committee, the Conceptual Conservation Scenario was presented and described in narrative form. A map was not prepared. Also at the direction of the MSHCP Advisory Committee, the Conceptual Conservation Scenario was intended to address the life history requirements of as many species as possible on the species list developed by the MSHCP Advisory Committee (*Table 2-2*).