Draft Summary of the Joint Meeting
Science Advisory Panel to the Marine Reserves Working Group
Science and Statistical Committee Ad-Hoc Marine Reserve Committee

October 1-2, 2001
Santa Barbara, California

This report summarizes material that was presented and discussed at a joint meeting of the Science Advisory Panel to the Marine Reserves Working Group (MRWG) of the Channel Islands National Marine Sanctuary (CINMS) Advisory Council and the Scientific and Statistical Committee (SSC) of the Pacific Fishery Management Council (PFMC). The meeting was held October 1-2, 2001 in Santa Barbara and was attended by CINMS staff, a subset of Science Panel members, the SSC's ad hoc Marine Reserve committee, and interested members of the public. The objective of the meeting was to clarify the scientific basis for the Science Panel's recommendation to the MRWG with respect to the range of sizes of proposed marine reserves in the CINMS.

In order to evaluate the Science Panel's recommendation, it is important to first understand their specific charge. The Science Panel did not site specific marine reserve locations in the CINMS. Instead, the MRWG asked the Science Panel to develop ecological criteria for reserve design (including location and size) in order to achieve two goals developed by consensus of the MRWG: (1) to protect representative and unique marine habitats, ecological processes, and populations of interest in the CINMS (hereafter referred to in this statement as the "ecosystem biodiversity" goal), and (2) to achieve sustainable fisheries in the CINMS by integrating marine reserves into fisheries management (hereafter referred to in this statement as the "sustainable fisheries" goal). The MRWG requested that the Science Panel give equal consideration to both goals. The MRWG constrained the Science Panel to define all "populations of interest" to be circumscribed by the boundaries of the CINMS.

The CINMS encompasses approximately 1252 square nautical miles from mean high tide to 6 nautical miles around each of the northern Channel Islands and Santa Barbara Island. The MRWG identified 119 species of interest to be protected by marine reserves in the CINMS, including plants, invertebrates, fish, seabirds, and marine mammals. The MRWG specified a minimum time horizon of 20 years for protection of populations of interest. The list of species to be protected included species that are: (1) economically and/or recreationally important, (2) keystone or dominant species, (3) candidate or listed species under the Endangered Species Act, (4) species that have shown long term declines in landings and/or average size, (5) habitat-forming species, (6) indicator or sensitive species, and (7) important prey species. Given the wide range of life-history characteristics of species of interest, it is nearly impossible to identify a reserve size or location that is optimal for all species. In addition, fish catch data for the CINMS (or other data from fishers on fish abundances at a scale of 1x 1 nmi^2) were not available for consideration by the Science Panel because of restrictions placed on the data by the Fisherman's Data Review Committee (a data oversight committee of fishing representatives). Thus, areas of

potentially high species diversity were not based on the actual availability of fished stocks. The Science Panel recommended a strategy of protecting representative marine habitats instead of attempting to design reserves for individual species.

The Science Panel recommended setting aside at least 30%, and possibly 50% of the representative and unique habitats in each biogeographical region in the CINMS. Because the CINMS is a complex region influenced by different ocean water masses and conditions, the Science Panel concluded that it was necessary to protect similar habitats in each of three unique biogeographical regions. Vulnerable habitats, such as giant kelp, eelgrass and surfgrass, were considered explicitly to ensure that such habitats are represented adequately in reserves. Vulnerable species, such as endangered seabirds and breeding marine mammals, also were included among the ecological criteria to insure adequate representation. Given sufficient data, other marine species could be included among the ecological criteria for reserve design.

The Science Panel considered a variety of factors when developing its reserve size recommendation for the CINMS, including: (1) a general review of the marine reserve literature, (2) the PFMC's default harvest rate policy, (3) dispersal rates of macroalgae, invertebrates, and fish, and (4) concerns about emerging fisheries.

In developing its recommendations, the Science Panel considered the status of managed fisheries inside and outside of the CINMS. For some fisheries (e.g. abalone, sea cucumber, red sea urchins, some rockfish species), the Science Panel evaluated data from the CINMS collected by the Channel Islands National Park and other local marine scientists. For other fisheries, such data were not available for the CINMS area so the Science Panel evaluated the status of the fisheries based on data for southern California or west coast populations. The Science Panel considered recent changes in fisheries management (e.g., the California Department of Fish and Game cowcod closed area). In this case, the Science Panel determined that the cowcod closure is likely to contribute to rebuilding cowcod populations, and possibly other species protected within similar habitats in the southern CINMS. However, the Science Panel determined that such single species closures did not address conservation and fisheries issues for the broad range of species of interest and habitats of concern.

No systematic analytical assessments of populations within the CINMS were completed by the Science Panel. Instead, the Science Panel examined a variety of trend indices and other information. The top commercial fisheries in the Channel Islands (squid and red sea urchin) exhibit high variability in landings from year to year, whereas other fisheries have shown dramatic declines in abundance (e.g. some rockfish and sharks, abalone, CA sheephead, black sea bass, and sea cucumber). In addition, many species targeted by recreational and/or commercial fishers have significant interactions with other species (e.g. as predator or prey). Reductions in the numbers or changes in population size structures of targeted species can alter community structure through direct and indirect linkages. After considering the available data, the Science Panel concluded that, for some species, particularly those species with low reproduction and delayed maturity, the assumption that there is little or no effective protection from current

management strategies may be reasonable, especially over a time horizon of twenty years or more.

After examining the available literature on the use of marine reserves for fishery management, members of the Science Panel concluded that many of the studies assumed an excessive level of fishing in areas outside of reserves. In situations where management through effort control is consistently effective, the conclusions from some of these papers are not likely to provide appropriate guidance for determining the size of marine reserves used for fishery management.

The Science Panel compiled information on marine reserves from a broad review of the scientific literature. Although numerous studies evaluated the impacts of marine reserves on fisheries, few studies of marine reserve size were based on information pertaining specifically to the U. S. west coast. In the CINMS, there is one very small marine reserve on the northeast side of Anacapa Island. Data collected inside and outside the marine reserve show significant increases in abundance and size of fished species in the reserve. Because of the limited data from marine reserves in the CINMS, the Science Panel relied mostly on empirical data from other regions and theoretical studies to estimate the range of reserve sizes that are likely to contribute to ecosystem biodiversity and sustainable fisheries. The Science Panel identified the need for additional study of the potential role of marine reserves as a conservation and fisheries management tool on the U.S. west coast. However, the consistency of responses in reserve systems from throughout the world supports the notion that the general findings from studies focused on other locations may be applicable to the U. S. west coast.

Specific recommendations for reserve size depend on the goals for marine reserves. Although most of the studies considered evaluations of fisheries yields, some of the studies were related to population persistence or ecosystem biodiversity. Most theoretical studies and limited empirical data indicated that protecting a minimum of 10 to 40% of all marine habitats is needed to conserve ecosystem biodiversity. If reserves are designed for fisheries enhancement and sustainability, most theoretical studies and limited empirical data indicated that protecting 20 to 50% of fishing grounds will minimize the risk of fisheries collapse and optimize long term sustainable catches. Several studies suggested that stocks should be maintained at 60-75% of their natural population size if reserves are to be used as the primary management approach. Without other management measures, highly mobile and migratory species may require very large closures (70-80%). The Science Panel developed a histogram showing the distribution of optimal marine reserve sizes, assembled from all the theoretical studies that they examined. The resulting distribution was very broad, ranging from 5-80% of a species' range. The central tendency of the distribution was centered in the range of 30-50%, which provided the primary impetus for the Science Panel's recommendation for reserve size. In this regard, the Science Panel's recommendation is a meta-analysis of theoretical studies, providing a distribution that could be used in a more formal Bayesian context. When asked by the SSC whether or not their recommendation of reserve size could be applied generally to areas outside of CINMS, the Science Panel responded that a 30-50% set aside could be appropriate for other regions trying to

achieve similar goals of ecosystem biodiversity and sustainable fisheries for a diverse array of species and habitats.

One of the Science Panel members argued that, to the extent that a 30% set aside corresponds to protection of 30% of virgin spawning biomass, then a 30% minimum reserve size is consistent with the American Fishery Society published guidelines for prevention of extinction risk in rockfishes (which are characterized as very low productivity species). A 40% area set aside would likely achieve the goals of the PFMC's harvest policy to maintain a minimum of 40% of virgin spawning biomass (VSB) to achieve Optimum Yield (OY). This 40%VSB target for OY has also been adopted by the State's Nearshore Fisheries Management Plan. Larger reserves (>40%) may be needed to achieve timely rebuilding of highly depleted stocks (e.g. the cowcod closed area). If stocks are rebuilt and fishing effort reduced to maintain VSB outside of reserves, then large reserves designed strictly for single species management could be reduced in size.

A third line of reasoning employed by the Science Panel relates to the dispersal distances of populations of concern. The Science Panel presented information on population genetics that suggested the dispersal distances of fishes, in contrast to macroalgae, are relatively large and in the range of 10-1,000 km. Thus, to insure that populations in reserves replenish themselves and do not simply export their larvae to unproductive areas (= sinks), reserves must either be quite large or highly networked. Ideally, the size of a single reserve should depend on the potential dispersal distance, population growth rate, and fishing pressure on species of concern. Movement of organisms between reserves and fished areas will decrease as the size of the reserve increases, and for this reason, the Science Panel recommended that conservation goals will be better served by large reserves (>30% of the CINMS). However, net emigration out of reserves is required if fisheries are to benefit from spillover of adults and juveniles. Therefore, to better serve fisheries for species with low to moderate dispersal potential, the Science Panel recommended that reserves be spaced out across a management area and not exceed 50% of the CINMS. To meet multiple goals, the Science Panel recommended networks must incorporate reserves of a variety of sizes.

The Science Panel also was concerned about the problem of reacting to emerging fisheries, including, for example, that for sea cucumbers in the Channel Islands. Emerging fisheries often require remedial management attention to rectify inadequate controls on fishing during their development. The Panel saw merit in the ecosystem protections provided by marine protected areas, even for species that may not currently be the focus of targeted fisheries.

In their recommendation, the Science Panel did not explicitly consider changes in existing fishery management regulations outside of the CINMS. To enhance conservation benefits and the potential for fisheries to be sustainable over the long-term, the Science Panel recommended either limiting catch outside of the reserves to current levels or reducing catch if current levels are insufficient to achieve sustainability. The Science Panel believes effort reduction outside marine reserves may be needed because displacement of fishing effort from within reserves may

cause fishing effort outside reserves to become concentrated. The Science Panel considers this recommendation especially important initially after reserves are established, when the benefits from growth of populations within reserve boundaries have not yet occurred. Concentrated fishing effort outside reserves may cause dramatic declines in fished populations. Declines in fished populations may not only affect the long-term sustainability of fisheries, but they may also hamper the ability of marine reserves to meet the biodiversity goal identified by the MRWG. The Science Panel's recommendation of reduced effort is based on the assumption that many fisheries in CINMS are at or over their capacity to withstand additional fish mortality.

Because of the complexity upon which their recommendation on reserve size is based, the Science Panel recommended continued evaluation of the effectiveness of marine reserves to determine whether subsequent alteration of reserve design (reduction or increase) is appropriate.