MPAs and Research Needs within the Monterey Bay National Marine Sanctuary

By Doyle Hanan

There are uncertainties regarding the effectiveness of MPAs especially in temperate regions (see Auster and Shackell, 2000; Salomon *et al.*, 2002; Kaiser 2005; Laurel and Bradbury, 2006). Research is required to improve scientific knowledge regarding MPAs while providing guidance to resource managers about the efficacy of MPAs, especially when considering new MPAs within existing national sanctuaries. Moreover, research and monitoring within and around MPAs should promote better understanding of optimum design and ecological conditions, as well as, socioeconomic costs and benefits for targeted resources. To correctly evaluate potential population and habitat effects, research must provide baseline knowledge of species and environmental condition; then management can act utilizing this best available scientific knowledge.

Management consideration of existing regional fisheries, fisheries regulations, and area closures is imperative when evaluating the usefulness of MPAs with respect to the resources they are designed to sustain (i.e. meeting the NOAA 2006-2011 Strategic Plan's goal of increasing the number of fish stocks managed at sustainable levels; see NOAA, 2005). As a tool for managing fisheries resources, MPAs are touted as able to sustain low productivity stocks and optimize production of healthy stocks with an overall goal of re-establishing or maintaining “biodiversity” of an ecosystem under consideration. However, MPAs cannot operate independently of other forcing factors acting upon the ecosystem in question and as noted by Field *et al.* (2006), fishing is typically the primary action limited by MPAs. Therefore, MPA effects on fish stocks, fisheries, and ecosystems in general must be central to any policy decisions concerning MPA implementation.

Scientific information regarding the effects of MPAs on marine resource population dynamics is essential to understanding the subsequent effects on fisheries yield and to assessing the overall effectiveness of MPAs for increasing the "number of protected species that reach stable or increasing population levels" (NOAA, 2005). MPAs may have the potential to alter life-history parameters such as growth and natural mortality rates as a result of changes in community structure (predator, competitor, and prey abundance). For example, Boersma and Parrish (1999) remarked that, in theory, MPAs allow population growth in fish species through decreased adult mortality and increased average female fecundity. In such case, the production of adults and larvae and possible spillover to outside areas might ensure a sustainable population of these resources. However, increased size, abundance, and diversity of upper trophic-level species could also alter community structure and inadvertently increase mortality on populations targeted to benefit.

Hilborn *et al.* (2006) developed two quantitative models to evaluate California central coast MPA design criteria, based on adult and larval movement, as well as, population dynamics. Their models predicted very little build-up of species within these proposed MPAs over time and concluded that any notable increases in abundances would only be achieved for highly sedentary species such as abalone. In addition, Hilborn *et al.* (2006) demonstrated that the most critical parameters for MPA designation are not larval dispersal rates, but: 1) adult movement rates and 2) compensatory changes in post-settlement juvenile survival rates. These findings point to general research needs that should be addressed when considering establishment of MPAs within MBNMS, and include assessments of density and overall stock size in addition to life-history information for each life stage of commercially exploited and unexploited resources. Fisheries-based information particularly near MPA boundaries should be rigorously evaluated for potential effects of MPAs and reserves on life history trends and habitat condition in proposed MPA areas and boundaries.

The discussion below includes a general synopsis of current MBNMS research capabilities, followed by a brief description of regulatory-imposed research constraints and proceeds to an outline of research needs for MBNMS with regards to establishment of MPAs. Given these considerations, the research and monitoring needs should be evaluated with this question in mind:

<u>Given the number of MPAs and closures extant within and near the MBNMS, and the habitat variability of these areas, are additional MPAs warranted to accomplish NOAA and MBNMS research needs?</u>

CURRENT MBNMS RESEARCH CAPABILITIES

Under the auspices of NOAA, MBNMS takes an "ecosystem approach to management." Within NOAA's strategic plan it is stated that management is "adaptive, specified geographically," and "takes into account ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse social objectives" (NOAA, 2005). Toward this approach, MBNMS has constructed a long-term monitoring (Sanctuary Integrated Monitoring Network (see www.mbnms-simon.org) and research program, and numerous research studies have been conducted within the sanctuary (see www.montereybay.noaa.gov/research/techreports for a list of studies dating from 1994). According to MBNMS, these programs employ a multidisciplinary approach, attempting to integrate five broad categories: 1) existing knowledge regarding the protected marine environment, 2) monitoring long-term changes of resources and their environment, 3) experimental studies, 4) modeling, and 5) information management.

MBNMS contains an existing array of closures (see Figures 1-3; Table 4 - Parrish section of this report). Of the 5,322 total square miles within MBNMS, reserves and closures now encompass more than 60% of nearshore rocky habitat, shelf, shelf break, slope, and abyssal regions. With the potential inclusion of the Davidson Seamount, the MBNMS will have an additional 660 square miles of unique deep-water habitat, which will require even more specialized logistics and research. Considering funding and staffing constraints, effectual assessment and management become an enormous task for MBNMS. Numerous logistical considerations must be taken into account while developing reliable research and monitoring regimes in addition to the sanctuary charge of cataloging and monitoring all species within MBNMS. If federal funding is not readily available, other funding sources such as grants and private funding might be attempted. However, a cautionary note applicable to scientific endeavor, private funding may present conflicts of interest due to potential organizational bias and interests from the funding source.

While the research goals and programs of the MBNMS are commendable, pressing research needs should be prioritized and addressed to determine the baseline status of exploited and unexploited resources and their habitats. It appears that no additional closed areas, reserves, or MPAs are required within MBNMS to accomplish the research and monitoring objectives. These include biological community structure surveys, assessments of density and overall stock size, collection of life-history information for both commercially exploited and unexploited species, as well as, research on movement patterns of adult, juvenile, and larval fish, and collection of fisheries-based data.

RESEARCH CONSTRAINTS

Comparing Marine Protected Areas with Outside Regions

Theoretically, MPAs provide spatially based (pre-defined "control") areas as ecological reference points to which other marine regions can be compared. Such comparisons are often necessary for assessing the overall effectiveness of MPAs. However, caution must be used when attempting to make scientific comparisons between MPAs and outside areas. Specifically, the comparison of biological parameters (e.g. abundance, size, and biomass) for individuals of a species inside MPAs to those in outside regions presents numerous difficulties. There have been only a few studies examining before and after changes within MPAs compared to reference points outside, and overall, data quality is variable and results are mixed (see Micheli *et al.* 2004; Botsford *et al.,* 2006). For example, reserves are often situated in areas of high productivity, biodiversity, and abundance (Bergen and Carr, 2003) whereas nearby regions outside the MPA are usually less productive or may become overfished because the MPA limited access to the productive fishing area. For this reason, it is very difficult to compare changes in ecological considerations such as biodiversity. Movement of fish into and out of MPAs can lead to misinterpretation of fisheries data and the efficacy of MPAs (e.g. CPUE can be increased as adults migrate to fishing areas with increased/concentrated fishing effort; see Parrish, 1999).

There are difficulties in assessing the effects of MPAs when outside areas are strictly regulated. For example, there is no bottom fishing in the entire non-trawl Rockfish Conservation Area (RCA) as well as no trawling in state waters or within the federal essential fish habitat (EFH) designated area and no commercial or recreational non-trawl bottom fishing from 30-150 fathoms. This curtails catch for groundfish inside or outside of reserve areas in shelf or shelf break habitats. According to these regulations, there is no fishing for bottom fishes in regions inside and around the four deep water MPAs (Soquel Canyon, Portuguese Ledge, Point Lobos, and Big Creek), and in the deeper shelf areas (55-100 meters) of other reserve areas. It will be prohibitively expensive to assess the effectiveness of a large number of MPAs for a wide range of species (e.g. rockfish spp.) when there is no fishery dependent data available. To make up for this lack of data, agency research can be pursued, however ship time is very expensive and available time on established research cruises is difficult to secure. Therefore, the research is not likely to be accomplished.

Species likely to be fished in areas adjacent to MBNMS MPAs are Dungeness crab in shelf waters, spot prawn on the shelf break, and sablefish in waters deeper than 150 fathoms. Because sablefish are highly mobile on a large spatial scale, they would be protected by only very large MPAs and results of research on this species would also be limited by spatial constraints. Thus, perhaps some of the most pressing research needs (those of stock assessment and species movements into and out of MPAs) will be difficult (in some cases impossible) to obtain for species protected by MPAs within MBNMS.

Limitations on Species Caught Within Marine Protected Areas

The quantitative models developed by Hilborn *et al.* (2006) to evaluate California Central Coast MPA design criteria, demonstrated that the benefits of reserve size is highly sensitive to adult mobility of species intended to benefit. They concluded that all of the proposed central coast MPAs would have very little positive impact on increasing populations because of their small size and relatively high adult mobility of predominate marine resources. The 2006 fishery landings for the Monterey Port area include all of the fish landed inside the MBNMS study area (see Table 1 - Parrish section of this report). Epipelagic fishes, which are highly mobile, comprised 96.1% of the catch. These species would likely not benefit at the population level from MPAs within MBNMS nor would potential MPAs provide sufficient area for meaningful research on these species. The species that dominate the lower and middle trophic levels of the California Current are primarily epipelagic, mesopelagic, and bathypelagic species that will not be effectively protected by MPAs of the size under consideration in California nor within the available area of MBNMS; therefore additional MPAs within the sanctuary would likely be ineffectual.

MBNMS RESEARCH NEEDS

Before-After-Control-Impact (BACI) Analysis

Before-After-Control-Impact (BACI) observational studies are necessary to determine the impacts of potential environmental changes on population abundance, and should be incorporated into MBNMS MPA research planning prior to establishment of MPAs. The BACI approach can be used to assess abundance trends of resources within each MPA (or potential control site), and in adjacent or nearby areas (impacted site) for powerful comparative statistical analysis. The basis of the approach is to evaluate environmental disturbance or anthropogenic effects in an impact location that might cause a different pattern of change (before to after implementation of MPAs) compared to natural change in a control location. This can be detected as a statistical interaction in an analysis of variance (ANOVA) of replicate comparisons. BACI analysis can provide high levels of sensitivity for detecting impacts on marine communities or assemblages. However, in long-term studies, effects due to MPAs may be difficult to separate from those due to other sources. Thus, pairing treatments of control and impact sites requires thorough consideration because notable differences may cause the sites to respond differently to the same occurrence.

If MBNMS MPAs are phased in over time, it will be important to use an experimental design that accounts for time-treatment interaction. Hilborn *et al.* (2006) provided a case specific example of such an interaction, as whether the impact of MPAs, such as recovery of larval sources for juvenile settlement in protected areas, changes over time with changes in ecological conditions or due to protection from offshore fishing effects. To assess this type of time-treatment interactions and account for transient responses to the application of treatments, a staircase design could be used to stagger treatments applied to the experimental units over time (Walters *et al.*, 1988). Using a staircase design, environmentally similar experimental areas are paired and monitored overtime.

RECOMMENDATION

Before-After-Control-Impact analysis should be applied to MBNMS MPA monitoring surveys.

Biological Community Structure Surveys

Biological community structure surveys should be conducted, designed as a replicate BACI study, to monitor simple indices or trends in biodiversity (species abundance, diversity, percent occurrence) for large numbers of species in various habitats represented within MBNMS. Hilborn *et al.* (2006) noted that transect sampling regimes can be conducted with transects oriented across the strongest spatial gradients to survey across depths and sample many possible sites. Transect sampling can result in precise estimates over very large survey areas, but does not allow for the statistical power that more costly and labor intensive survey methods, such as stratified random sampling surveys can accommodate. Given the extremely large monitoring programs required for MBNMS, the risk of bias involved in transect sampling may be worth the surety of collecting observations at the largest possible number of sites.

It will be useful to map and measure habitat, distribution and abundance of key species, identifying habitat types and delineating habitat boundaries. Habitat features such as substrate, any plants, corals, live-bottom reef habitats, and water quality must be assessed. Methods of obtaining species and habitat information on a large-scale, including technologies such as fixed acoustic arrays (see Kenny *et al.* 2003) and remotely operated vehicles (ROV) can be used to examine habitats, as well as, fish and invertebrate species. Where possible, scientific survey techniques using commercial trawling gear should be used to obtain catch composition and biological information for deeper water species (this has succeeded with the NMFS Cooperative Groundfish Trawl Program).

RESEARCH OBJECTIVE 1.

Survey efforts must be carefully planned and implemented swiftly to ensure baseline information is collected before MBNMS MPAs are established. The Big Creek (and Punta Gorda) baseline should be resurveyed before any permanent monitoring program is designed. Subsequent to baseline surveys, long-term monitoring regimes should be established at multiple locations. Methodology for this type of work is not well developed for areas beyond diving depth and for species that are not sedentary. In particular, species that aggregate (i.e. bocaccio, chilipepper, and widow rockfishes) are very difficult to quantify with the sampling intensity usually used in scientific surveys.

Density and Overall Stock Size

Stock assessments are needed for both commercially exploited and unexploited species of resources within MBNMS. The status and trends for species of economic importance must be evaluated to ascertain baseline abundance information before MBNMS MPAs are established. Further, the status of many species that have not been exploited needs similar baseline evaluation. At a minimum, stock assessments must be conducted for a few key indicator species inside and outside of MPAs. As discussed above, un-assessed species that may be of concern include those occupying habitats where extensive fishing has occurred in the past. Species in nearshore habitats affected by pollution and/or manmade environmental changes may also have low population abundances, as could cold-water species adversely affected by the warm water regime that has persisted since the late 1970's. These factors should be considered when selecting species for study.

RECOMMENDATION

A set of key indicator species should be compiled for research comparisons. The species should represent commercially exploited and unexploited populations, and sedentary and mobile species.

RESEARCH OBJECTIVE 2.

Stock assessments should be completed for the representative set of key indicator species.

Life-history Information

Studies of life history parameters at varying population densities are needed for fish and invertebrate species of economic importance within MBNMS. MPAs are likely to contain variable fish densities among regions and over time. The life stages most sensitive to density-dependent effects on recruitment and growth, should be determined in an effort to understand if MPAs potentially increase recruitment locally, or through dispersal of pre-recruits to adjacent areas open to fishing.

Life-history information collected from unfished sites (sites within MPAs/no take areas) must be compared to that from fished sites, to assess fisheries vs. environmental effects and to determine density dependent effects on natural history rates between sites. One may expect most density dependent factors (recruitment, growth at age, natural mortality, age at maturity, fecundity at age, natural mortality) to reduce productivity at high population density, but some life history rates, such as fecundity/unit total biomass, may increase in unfished sites due to increased average age.

RESEARCH OBJECTIVE 3.

Life-history information should be collected for all life stages of the representative set of key indicator species to assess density-dependent effects on recruitment and growth.

Movement Patterns

The single most critical need for evaluations of the effectiveness of MPAs is information on the movements of exploited species. It is imperative to monitor potential export of adults, juveniles, larvae, and eggs from existing MBNMS protected areas. Field et al. (2006) emphasized that movement and dispersal of larvae, juveniles, and adults impact both the efficacy of MPAs and fisheries yields. In the case of commercially exploited species, tracking the dispersal of adults is important for the interpretation of fisheries data and understanding fisheries yields. Tagging devices can be used to track movements from MPAs to outlying fishing areas, where marked adults can be captured or observed. Data on dispersal distances and numbers of marked adults captured outside of MPAs should be collected to assess potential spillover effects of MPAs due to natural movements. This can be especially important at MPA boundaries where spillover of adults may affect fisheries yield. Traditional tags can readily be used for tracking the adults of some species, and now electronic tags with microprocessors, some even with GPS tracking capabilities, are available. In addition, acoustic telemetry tracking has been successful.

Tagging studies on the rockfish species in deeper habitats are likely to face real difficulty due to the problems associated with air bladder and eye inflation when rockfishes are brought to the surface. Also, the Rockfish Conservation Area will prevent tag and recapture studies on the important shelf break species because fishing for these species is presently prohibited over most of the species core habitat and it will therefore be impossible to get enough recoveries to assess movement. It should be noted that while research on the movement of species is very important for assessment of MPAs, MPAs are not needed to carry out research on movement.

Information on larval and juvenile dispersal and recruitment is also important to understanding of the effects of MPAs on fish population dynamics and on fisheries. Biological data for these life stages can be analyzed along with physical information on hydrography, season, and inter-annual climate variation to provide insight to dispersal patterns.

Detection of signature geochemical compounds in otoliths, statoliths, and exoskeletons, as well as, tag and release studies using florescent chemicals in otoliths have also been used to study dispersal patterns in larval fish and in invertebrates (see Miller *et al.*, 2004). Research on genetic differentiation for populations of fish and invertebrates can reveal patterns of gene flow and provide inference about dispersal patterns at varying life-history stages (Sotka *et al.*, 2004).

RESEARCH OBJECTIVE 4.

Tagging and tracking studies should be conducted on the representative set (or subset thereof) of key indicator species. At a minimum, tagging studies should be undertaken to document movements of adults. Documentation of movements at various additional life stages is also advised. Where practical, studies of genetic differentiation may allow inferences of information over broad geographic region. The potential for genetic research on some species should be explored.

Fisheries-Based Information

Fisheries-based data could also be used to indirectly evaluate potential spillover just outside MPA (in outlying fishing areas and at boundaries; but see Field *et al.*, 2006 for a discussion of potential bias). These data should be collected, at a minimum, for few indicator species in the major fisheries. In addition, to achieve some insight into the effects of recreational fishing within MBNMS, the numbers of active fishing licenses, total fishing effort, and spatial distribution of effort should be assessed.

RESEARCH OBJECTIVE 5.

A thorough fisheries assessment for the commercially exploited subset of selected key indicator species should be conducted for MBNMS before MPAs are established.

SUMMARY

Recently twenty-nine California central coast MPAs (effective 21 September, 2007) were incorporated into a state nearshore reserve system. The new federal EFH network of MPAs (effective June 12, 2006) includes three federal MPAs inside the MBNMS (1,435 sp. mi.) and the Davidson Sea Mount (775 sq mi.). More than 60% of the NBNMS study area is now protected by reserves. Therefore, it is a critical time to consider the potential success of any MBNMS MPAs, as well as, ensuring the proper assessment of the system's effectiveness in those endeavors. Within the 4,217 sq. mi. MBNMS study area, reserves and closures occupy a predominance of nearshore rocky habitat, in addition to shelf, shelf break, slope, and abyssal regions. Thus, the existing Sanctuary, and especially with the addition of the Davidson Seamount, encompasses the important habitats in the MBNMS region. Administrators of MBNMS are faced with the already enormous task of prioritizing and implementing research objectives. Baseline physical and biological information on habitats and species should be assessed before MPAs become established. Accommodations that facilitate fisheries resource monitoring and stock assessment should be identified and implemented. Also, there is substantial uncertainty regarding the appropriate size and spacing, implementation and effectiveness of MPAs in general. MBNMS administrators should assess the effectiveness of existing

MPAs and closed areas prior to designating additional MPAs.

The record on funding MPA monitoring and research in California is not good. In 1993 three reserves were enacted in California, two of these had extensive surveys and monitoring in the first year (Punta Gorda), or first couple of years (Big Creek) after the reserves were established. To date, there has been no follow up monitoring, repeat of surveys or analyses on the success of the reserves in protecting individual species or any analysis of ecosystem effects of MPAs (which is far more difficult than assessment of trend of individual species). Based on the number of MPAs in the South/Central phase of the State MLPA process and the Channel Islands process; the expected number of MPAs in California is expected to exceed 100 by the time the MLPA process is completed. In addition an extensive network of reserve areas (EFH) was recently established by the Pacific Fisheries Management Council. It is clear that there will soon be intense competition for funds to study MPAs and other reserves, it is unlikely that funding will be anywhere near the amount necessary to adequately monitor or research the reserves and MPAs expected to be in existence in California by 2010. It is clear that the limiting factor will be funding for monitoring and research, not availability of MPAs.

In conclusion, based upon this examination of MBNMS research needs, three points should be restated regarding research objectives: First, given the extent of the existing MBNMS protected areas, funding and other logistical constraints are likely to limit the ability to implement basic research needs. Second, sufficient baseline information must be collected in a timely fashion at multiple sites (already large in number) before permanent research and monitoring regimes are established. Third, given the uncertainties which surround the designation and management of MPAs, there is a responsibility to assess effectiveness of existing MBNMS protected areas prior to summarily restricting use of more ocean area.

Finally, no additional MPAs are required within MBNMS to accomplish the research and monitoring objectives reviewed and outlined here. These include biological community structure surveys, assessments of density and overall stock size, collection of life-history information for both commercially exploited and unexploited marine resources, research on movement patterns of adult, juvenile, and larval stages of important species, and collection of fisheries-based data.

LITERATURE CITED

Auster, P. J., and Shackell, N. L. 2000. Marine protected areas for the temperate and boreal Northwest Atlantic: The potential for sustainable fisheries and conservation of biodiversity. Northeastern Naturalist 7(4):419-434.

Bergen, L. K., and Carr, M. H. 2003. Establishing marine reserves: How can science best inform policy? Environment 45:8-16.

Boersma, P. D., and Parrish, J. K. 1999. Limiting abuse: marine protected areas, a limited solution.

Botsford, L. W., Micheli, F., and Parma, A. M. 2006. Biological and ecological considerations in the design, implementation and success of MPAs. Pages 109-148 *in* Report and documentation of the expert workshop on marine protected areas and fisheries management: Review of issues and considerations. Rome, 1214 June 2006. FAO Fisheries Report No. 825. 332pp.

Field, J. C., Punt, A. E., Methot, R. D., and Thomson, C. J. 2006. Does MPA mean 'major problem for assessments'? Considering consequences of place-based management. Fish and Fisheries 7:284-302.

Hilborn, R., Parrish, R., and Walters, C. J. 2006. Peer Review: California Marine Life Protection Act (MLPA) science advice and MPA network proposals. 69 pp.

Kaiser, M. J.   2005. Are marine protected areas a red herring or fisheries panacea? Canadian Journal of Fisheries and Aquatic Sciences. 62:1194-1199. Kenny, A. J., Cato, I.

Desprez, M., Fader, G., Schutteenhelm, R. T. E., and Side, J. 2003. An overview of seabed-mapping technologies in the context of marine habitat. ICES Journal of Marine Science 60:411-418.

Laurel, B. J., and I. R. Bradbury. 2006. “Big” concerns with high latitude marine protected areas (MPAs): trends in connectivity and MPA size. Canadian Journal of Fisheries and Aquatic Sciences 63:2603-2607.

Micheli, F., Halpern, B. S., Botsford, L. W., and Warner, R. R. 2004. Trajectories and correlates of community change in no-take marine reserves. Ecological

Applications 1709-1723.

Miller, J. A., and Shanks, A. L. 2004. Evidence for limited larval dispersal in black rockfish (*Sebastes melanops*): implications for population structure and marine-reserve design. Canadian Journal of Fisheries and Aquatic Sciences 61(9): 1723-1735.

NOAA, 2005. New priorities for the 21st century - NOAA's strategic plan. Updated for FY 2006-FY 2011. 22 pp.

Parrish, 1999. Marine reserves for fisheries management: Why not? Cal-COFI 40:77-86.

Sotka, E. E., Wares, J. P., Barth, J. A., Grosberg, R. K., and Palumbi, S. R. (2004) Strong genetic clines and geographical variation in gene flow in the rocky intertidal barnacle *Balanus glandula*. Molecular Ecology 13(8):2143-2156.

Saloman, A. K., Waller, N. P., McIlhagga, C., Yung, R. L., and C. Walters. 2002. Modeling the trophic effects of marine protected area zoning. Aquatic Ecology 36:85-95.

Walters, C. J., Collie, J. S., and Webb, T. 1988. Experimental designs for estimating transient responses to management disturbances. Canadian Journal of Fisheries and Aquatic Sciences 45:530-538.

March 9, 2008

Dear Richard,

I have gone over the comments of your reviewer regarding the draft of "MPAs and Research Needs within the Monterey Bay National Marine Sanctuary." I note that overall the reviewer found that, "Most of the suggestions for research seem sound, and reflect much of the common themes regarding the needs for evaluating MPAs and using them to evaluate the effects of fishing and other factors on fish populations and the marine ecosystem. The author also brings up a number of good ideas about important complications in the conduct and interpretation of these research programs."

The document, “MPAs and Research Needs within the Monterey Bay National Marine Sanctuary”, is intended as a brief evaluation of the fundamental scientific research required to assess the effectiveness of the MPAs already in place in the Monterey Bay National Marine Sanctuary (MBNMS). As such it is neither positive nor negative regarding the existence and implementation of MPAs. However, as noted in the paper, given the fact that there is already an extensive network of reserves within the MBNMS study area, it is of critical importance to conduct basic scientific research now. It is important to be cautionary in the face of implementing more reserve areas without sound scientific basis. The MBNMS does have the responsibility to assess effectiveness of existing protected areas prior to implementing more reserves.

Sincerely,
Doyle Hanan