Southwest Fisheries Science Center
Administrative Report H-00-03

RECOMMENDED OVERFISHING DEFINITIONS AND CONTROL RULES FOR THE WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL'S BOTTOMFISH AND SEAMOUNT GROUNDFISH FISHERY MANAGEMENT PLAN

Robert B. Moffitt and Donald R. Kobayashi

Honolulu Laboratory, Southwest Fisheries Science Center
National Marine Fisheries Service, NOAA
2570 Dole Street, Honolulu, Hawaii 96822-2396

May 2000

NOT FOR PUBLICATION

OVERFISHING DEFINITIONS AND CONTROL RULES

The goal of the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) is to ensure the long-term sustainability of fish catches by halting or preventing overfishing and by rebuilding any overfished stocks. Overfishing occurs when fishing mortality (F) is higher than the level at which fishing produces the maximum sustainable yield (MSY). The MSY is the maximum long-term average yield that can be produced by a stock on a continuing basis. A stock is overfished when stock biomass (B) has fallen to a level below that which can produce MSY. So there are two aspects that managers must monitor to determine the status of a fishery: the level of F in relation to F at MSY (F_{MSY}) and the level of B in relation to B at MSY (B_{MSY}).

The Technical Guidance for National Standard 1 (Restrepo et al., 1998) requires that "control rules" be developed which identify "good" versus "bad" stock conditions and which describe management action that will influence a control variable (e.g. F) as a function of some stock size variable (e.g., B), to achieve good stock conditions. Each control rule must define two reference points (or thresholds) called "status determination criteria": one for F to define when overfishing is occurring, and one for B to define when the stock is overfished. The status determination criteria for F is the maximum fishing mortality threshold (MFMT), and the status determination criteria for B is the minimum stock size threshold (MSST). When F exceeds the MFMT, overfishing is occurring, and when B falls below MSST the stock is overfished. When either of these two conditions occurs NMFS must notify Congress that the stock is overfished, and fishery managers must take action to halt overfishing or to rebuild the stock. A reasonable MSY control rule template for Western Pacific bottomfish (Fig. 1) may be derived from the default MSY control rule suggested by Restrepo et al. (1998).

The y-axis labeled F/F_{MSY} (Fig. 1) indicates the variable which managers must control as a function of B/B_{MSY} on the x-axis. The default MFMT recommended by the Technical Guidelines is an upper limit set at F_{MSY}, shown as a horizontal line at 1 = MFMT = F/F_{MSY}. In applying the MSY control rule, F (or rather the ratio F/F_{MSY}) must not be allowed to exceed the MFMT. Even though a stock with a B level well above B_{MSY} can support larger F values for a limited time as B declines towards B_{MSY}, limiting F to F_{MSY} is a better precautionary approach which greatly reduces the possibility of B being reduced below B_{MSY}. Other types of control rules would allow higher F levels under specified conditions, but such rules require reliable measures of B and a thorough understanding of stock dynamics.

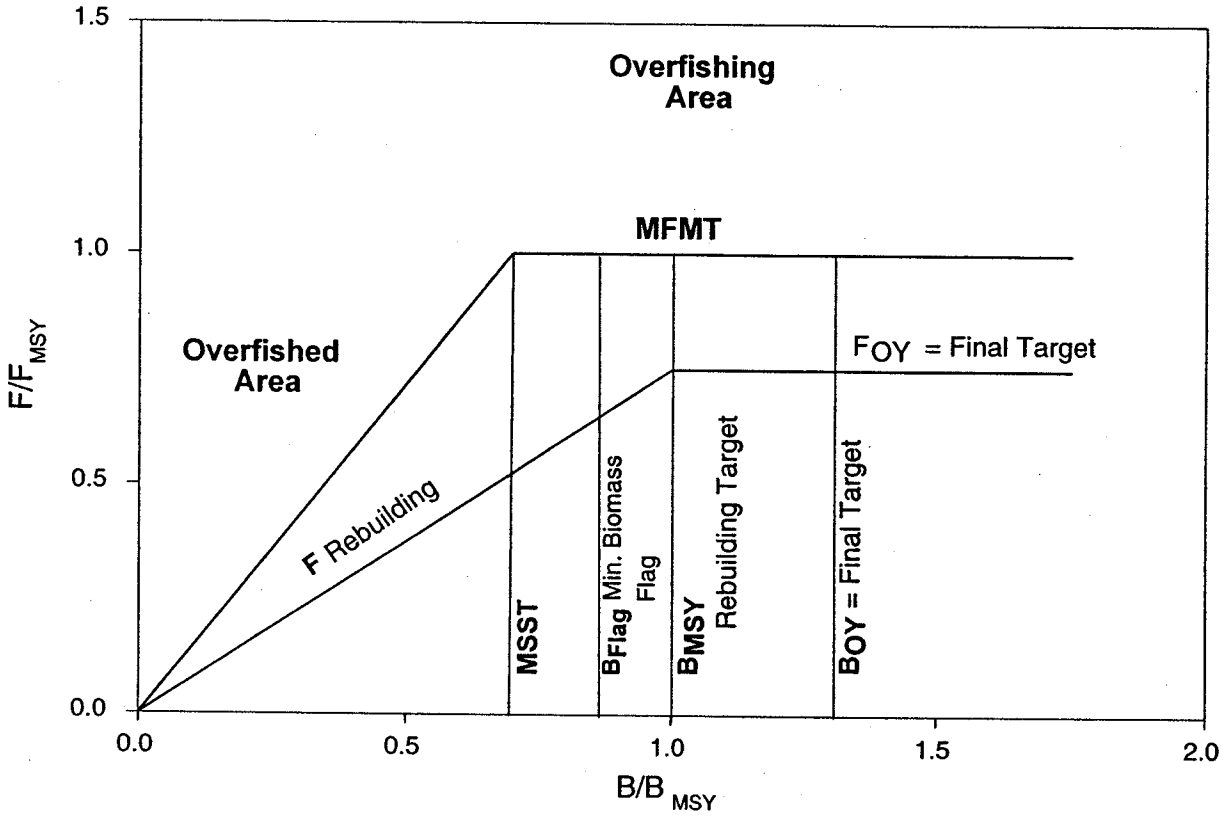

Figure 1. MSY Control Rule and Reference Points

The MSST is shown in Figure 1 as a vertical line at a B level substantially below B_{MSY}. This allows for some natural fluctuation of biomass around B_{MSY} under an MSY harvest policy. When B falls below MSST, however, the stock is considered to be overfished and then F must be reduced below the MFMT by an amount that depends on the severity of the stock depletion, the stock's capacity to rebuild, and the desired stock recovery time. A precautionary minimum biomass flag (B_{FLAG}) (Fig. 1) is defined so that if B drops below B_{FLAG} managers are prompted to implement remedial action before biomass reaches the MSST.

Rebuilding plans can be developed in a number of ways depending on the fishery and available fishery data (e.g. constant harvest, biomass related quotas, and biomass related effort restrictions). The precautionary "optimal yield" (OY) control rule as illustrated by the line labeled $F_{REBUILDING}$ in Figure 1 is recommended for the Bottomfish and Seamount Groundfish fisheries. OY is MSY as reduced by relevant socioeconomic factors, ecological considerations, and fishery biological constraints to provide the greatest long-term benefits to the

nation. Under the suggested OY control rule (adapted from the Restrepo et al., 1998 default guidelines), when B is below MSST, F is controlled as a linear function of B, until a rebuilding target of B_{MSY} is reached at F_{OY}. A final OY target (B_{OY}) somewhat greater than B_{MSY} is achieved by keeping fishing effort at F_{OY} (Fig. 1). Simulation results have indicated that when fisheries are managed at F_{OY}, equilibrium biomass will be maintained at about 1.30 B_{MSY} and resulting equilibrium yield (OY) will be at about 95% of MSY (Mace, 1994).

APPLICATION OF THE OY CONTROL RULE TO THE BFMP FISHERIES

Background

The Western Pacific Regional Fisheries Management Council is responsible for the management of bottomfish and groundfish resources within the Exclusive Economic Zone (EEZ) surrounding American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and Hawaii. In the western Pacific the fishery targets the deep slope eteline snapper/grouper complex and the shallower lethrinid/*Lutjanus* complex. Most of the fishing grounds occur within 3 miles of shore and are managed by the local governments. In Hawaii, the bottomfish fishery is based solely on the deep slope complex, lacking major components of the shallow complex. The Hawaiian Archipelago is divided into three bottomfish management zones, the main Hawaiian Islands (MHI), the Mau zone, and the Ho'omalu zone. The MHI is similar to the western Pacific areas in that the fishery exists largely within 3 miles of shore and is managed by the local government. In contrast, the Northwestern Hawaiian Island (NWHI) bottomfish fishery exists largely in federal waters and is managed under the Bottomfish and Seamount Groundfish FMP (BFMP). In addition to the Hawaiian bottomfish resource, a seamount resource dominated by pelagic armorhead exists at Hancock Seamounts in the northwest extreme of the Hawaiian Archipelago EEZ and extends outside the EEZ to the north along the Southern Emperor Seamount chain. The central Pacific armorhead stock has been heavily overfished since the mid 1970s, and a moratorium was placed on this fishery within the EEZ in 1986. However, since only about 5% of the fishing grounds occur within the Hawaiian EEZ and foreign fishing has continued outside the EEZ, no recovery in the stock has been achieved despite three consecutive 6-year moratoria.

Data Richness

Available biological and fishery data are poor for all species and island areas covered by the BFMP. Data collection systems are managed by the local island governments and vary widely in format and coverage. Data is generally restricted to commercial landings by species and catch-per-unit-effort (CPUE)

for the multispecies complex as a whole. Total effort cannot be adequately partitioned between the various Bottomfish Management Unit Species (BMUS) for any fishery or area except in the MHI where the data allows identification of targeted effort for the four major species caught. Biomass (B), maximum sustainable yield (MSY), and fishing mortality (F) estimates are not available for any single BMUS but have been calculated for the deep water complex as a whole in Hawaii. Similar deepwater complex MSY values can be calculated for the other island areas, but no estimates of F are available for these regions and the resulting MSY estimates are not representative of the fishery because they do not include the substantial shallow water complex component.

With this level of available data we will establish limits and reference points based on the multispecies fishery stock as a whole. In accordance with the NSGs, the MSY (or OY) control rule is to be applied to individual species within a multispecies stock whenever possible. When this is not possible, MSY (or OY) may be specified for one or more species and used as an indicator for the multispecies stock. Since each species stock within the multispecies complex will be affected differently when fished at species complex F_{OY}, we are obligated to protect each species stock from mortality rates that would lead to required protection under the ESA. For the fisheries encompassed by the BFMP, pelagic armorhead will serve as the indicator species for the seamount groundfish fishery, and the multispecies bottomfish complex as a whole will be used to establish limits and reference points for the four bottomfish fisheries under the OY control rule found in figure 1. Where possible, available data for a particular fishery/species will be used to evaluate the status of individual BMUS stocks in such a manner as to prevent recruitment overfishing on any component while maintaining the multispecies biomass near B_{MSY}. When better data and the appropriate multispecies stock assessment methodologies become available, all stocks will be evaluated independently without proxy.

Establishing Reference Point Values

Standardized values of CPUE and effort (E) will be used for the purpose of establishing limit and reference point values as proxies for relative biomass and F, respectively. Limits and reference points will be calculated in terms of $CPUE_{MSY}$ and E_{MSY} as follows:

Value	Proxy	Explanation
MFMT (F_{MSY})	E_{MSY}	operational counterpart
F_{OY}	0.75 E_{MSY}	suggested default scaling for target
B_{MSY}	$CPUE_{MSY}$	operational counterpart
B_{OY}	1.3 $CPUE_{MSY}$	simulation results from Mace (1994)
MSST	0.7 $CPUE_{MSY}$	suggested default (1-M)B_{MSY} with M=0.3*
B_{FLAG}	0.91 $CPUE_{MSY}$	suggested default (1-M)B_{OY} with M=0.3*

*Deepwater snapper M estimates range from 0.3-0.55; 0.3 is the precautionary choice for this application.

When reliable estimates of E_{MSY} and $CPUE_{MSY}$ are not available they will be estimated from the available time series of catch and effort values standardized for all identifiable biases using the best analytical tools available. $CPUE_{MSY}$ will be calculated as half a multiyear moving average reference CPUE ($CPUE_{REF}$). The multiyear reference window will be objectively positioned in time to maximize the value of $CPUE_{REF}$ (Fig. 2). E_{MSY} can be estimated similarly or, following Restrepo et al. (1998), $E_{MSY} = E_{AVE}$ where E_{AVE} represents the long term average effort prior to declines in CPUE. When multiple estimates are available, the more precautionary value will be used. All values will be calculated using the best available data. When new data become available, reference point values will be recalculated.

In Hawaii, archipelago-wide estimates of MSY, B_{MSY}, MFMT, MSST, E_{MSY}, $CPUE_{MSY}$, OY, B_{OY}, F_{OY}, E_{OY}, and $CPUE_{OY}$ will be calculated as the weighted average of estimates for each management zone. Weighting factors are calculated as the zone-specific fraction of the total length of 100-fm contour in the archipelago and are used in calculation of archipelago-wide F and CPUE values. These

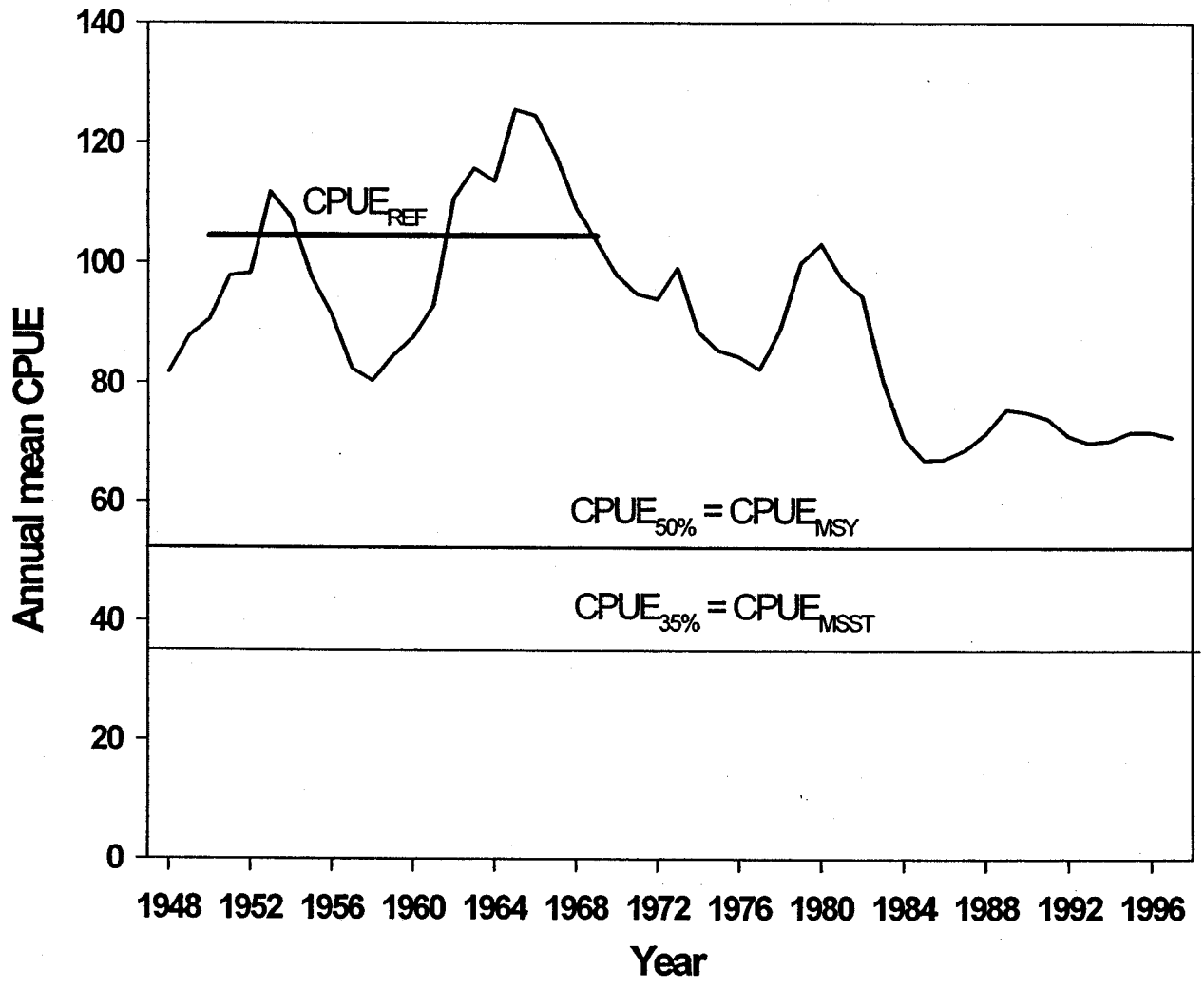

Figure 2. Multiyear Reference Window

values are in terms of the deep slope complex as a whole and are not based on any specific BMUS. The 100-fm contour has previously been shown to be a useful measure of available bottomfish habitat (Ralston and Polovina, 1982).

Although archipelago-wide multispecies values are used to determine overfishing and overfished conditions in Hawaii, values

for each zone can be used to detect local depletion. Management measures designed to meet OY conditions within each zone are encouraged. Such measures to correct overfishing, overfished, or locally depleted stock conditions may include area closures, seasonal closures, reduction of permits within a limited entry system, or establishment of individual effort or catch limits.

Prevention of Recruitment Overfished Stocks

The above OY control rule limits and reference points are applied to the multispecies stocks and not to individual component species stocks. While managing the multispecies stock to provide maximum benefits to the Nation, we must also ensure that the resulting fishing mortality rate does not reduce any individual species stock to a level requiring protection under the Endangered Species Act (ESA). Preventing recruitment overfishing on any component stock will satisfy this need in a precautionary manner. The ratio of a current spawning stock biomass proxy (SSBP), CPUE scaled by percent mature fish in the catch, to reference levels will be used to evaluate species stock status in regard to recruitment overfishing. When the spawning stock biomass proxy ratio, $SSBP_t/SSBP_{REF}$ drops below 0.20 for any species, that species will be considered recruitment overfished and management regulations will be imposed to reduce fishing mortality on this species regardless of the effects on other healthy species stocks. A simple two-level stepwise spawning stock recovery plan is recommended, which should minimize unnecessary fluctuation in specified fishery effort due to uncertainties in measuring the spawning stock biomass proxy ratio in these data-poor fisheries. When the SSBP ratio is less than or equal to 0.10, fishing mortality will be reduced to zero for this species. When the ratio is greater than 0.10 but less than or equal to 0.20, fishing mortality for this species will be reduced to 0.25 F_{OY}. When the ratio rebuilds to a level greater than 0.20, fishing mortality for this species will be maintained at 0.50 F_{OY} until spawning stock recovery is completed and the ratio reaches 0.30. Management measures may include area closures, seasonal closures, fishing depth restrictions, gear restrictions, or total effort or take reductions. The best data available will be used for each fishery to estimate values.

REFERENCES

Mace, P. M.
1994. Relationships between common biological reference points used as thresholds and targets of fisheries management strategies. Can. J. Fish. Aquat. Sci. 51:110-122.

Ralston, S. and J. J. Polovina.
1982. A multispecies analysis of the commercial deep-sea handline fishery in Hawaii. Fish. Bull. 80(3):435-448.

Restrepo, V. R., G. G. Thompson, P. M. Mace, W. L. Gabriel, L. L. Low, A. D. MacCall, R. D. Methot, J. E. Powers, B. L. Taylor, P. R. Wade, and J. F. Witzig.
1998. Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act: NOAA Technical Memorandum NMFS-F/SPO-31. Washington, DC: US Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service.