

broad range of stress-related effects and other factors that might lead to unobserved dolphin mortalities. These data, however, are insufficient to quantify potential population-level impacts or determine whether population recovery might be delayed, because sample sizes were small and baseline data unavailable. For example, in implementing a specifically mandated necropsy program that was conducted between 1998 and 2000, it was possible to obtain samples from only 56 dolphins; a number that is insufficient to make population-level inferences. Additionally, a chase-encirclement stress study, was conducted during August and October of 2001. Because of the experiment's complexity and logistical challenges, it was recognized from the outset that sample sizes for the studies would be limited and that population-level inferences were unlikely.

Notwithstanding these data limitations, NOAA Fisheries examined specific indirect effects that may negatively impact dolphin stocks. Specifically, NOAA Fisheries examined the possibility that cow-calf pairs are separated during chase and encirclement, causing the subsequent death of the calf. Analyses of purse-seine sets suggests that some separation occurs. However, more conclusive mortality estimates relative to chase do not exist, as direct observations currently are not feasible. Additional mortality associated with separation is possible in instances where dolphins are chased but not encircled. However, mortality estimates relative to chase do not exist, as direct observations are not feasible. Even if correct, estimates of confirmed indirect dolphin mortality due to cow-calf separation do not substantially increase the total levels of mortality for each stock.

Additionally, NOAA Fisheries investigated the frequency with which the fishery interacts with individual dolphins and with the dolphin stocks as a whole each year. For northeastern offshore spotted dolphins, there are over 5,000 dolphin sets per year, resulting in 6.8 million dolphins chased per year and 2.0 million dolphins encircled per year (on average for 1998–2000). For eastern spinner dolphins, there are about 2,500 sets per year, 2.5 million dolphins chased per year, and 300,000 dolphins encircled per year. For coastal spotted dolphins, there are about 154 sets per year, 284,300 dolphins chased per year, and 39,700 dolphins captured per year. NOAA Fisheries estimated that a northeastern offshore spotted dolphin is chased 10.6 and encircled 3.2 times, an eastern spinner dolphin is chased 5.6

and encircled 0.7, and a coastal spotted dolphin is chased 2.0 times and encircled 0.3 times per year on average. Unfortunately, there is much uncertainty surrounding these statistically estimated averages. Moreover, there are insufficient data to determine the impact of stress and other chase-related effects on dolphin populations. Additional research must be done on this before there will be sufficient data to yield definitive results.

Experts noted that there is inadequate information to make a determination on the existence or extent of indirect effects, as they relate to dolphin recovery. To assist the Secretary in answering this difficult question, a panel of five experts was asked to address the issue of indirect mortality. All five expert panelists indicated that indirect fishery effects, especially cow-calf separation and increased likelihood of predation, may account for the lack of expected dolphin recovery. The strength of their opinions varied greatly, however, noting the large amounts of uncertainty in the data. The IATTC noted that indirect effects (such as cow-calf separation, elevated stress hormones and enzymes, and heart damage) are speculative, given the absence of adequate data. The MMC provided no additional studies, but agreed that, “\* \* \* existing information does not provide a sufficient basis for quantifying any increased levels of mortality that occur during chase operations, reproductive failure resulting from stress, facilitated predation, post-release capture myopathy, or disruption of the tuna-dolphin bond.”

In sum the available information on indirect effects, including much of the information regarding cow-calf separation, is limited, and therefore bars population-level inferences of the effects of stress on dolphin stocks. Additional research is necessary to better understand these more complex effects on dolphin stocks. Accordingly, the best available information, including data on sets per year, mortality attributable to the fishery, indicators of stress in blood, skin and other tissues, cow-calf separation, the Expert Panel opinions, and other relevant information, indicates that indirect effects caused by purse-seine fishing are not impacting dolphins to a degree that would risk or appreciably delay recovery to optimum population levels.

*The Growth Rate Question.* For each depleted dolphin stock, is the observed population growth rate sufficient to ensure that each stock's recovery to OSP is not appreciably delayed?

To answer this question, NOAA Fisheries fit a population model to a time series of research vessel abundance estimates, using the time series of estimates of the incidental mortality from tuna vessel observer data (TVOD) collected by IATTC and national program observers, as well as TVOD as indices of abundance in a subset of the analyses. NOAA Fisheries also estimated growth rates for each dolphin stock and measures of uncertainty for each estimate. Finally, assessments from the members of the Ecosystem Panel were used when considering the estimated growth rates.

The assessment modeling produced additional information on the current depletion levels of two of the three depleted dolphin stocks. Depleted means that a marine mammal population's abundance is less than 60% of its carrying capacity or the maximum size of a particular population that can be sustained within a given area or habitat. Northeastern offshore spotted dolphins are at 20% and eastern spinner dolphins at 35% of their pre-fishery population levels and thus remain depleted under the MMPA. Similar estimates for coastal spotted dolphins are unavailable, due to a lack of data on fishery-related mortality and time-series abundance estimates from the early years of the fishery.

NOAA Fisheries estimated a “one-slope” and “two-slope” model of growth rates for dolphin populations. While the one-slope model assumes a constant growth over the period studied, the two-slope model allows for a change in the growth rate. The one-slope model indicates that the dolphin stocks are growing at low rates (1–2%) although there is a 95% confidence that they are not declining. The two-slope model results indicate that the growth rate decreased, but was still positive, for one stock but became negative for a second stock during this past decade. The two models produce roughly equally probable results.

Another important consideration in assessing the impact of the fishery on depleted stocks is to determine the time to recovery for these stocks under current conditions. Using the growth rates mentioned above in a population model, estimated times to recovery were determined for these two stocks. When abundances of the depleted stocks are projected into the future, the one-slope model predicts recovery in 78 years for northeastern offshore spotted dolphins, and in 65 years for eastern spinner dolphins. The two-slope model, having roughly equivalent support by the data, predicts that neither stock would recover in at least 200 years. This two-