Advisory Committee on Kangaroos) must approve the quota before the harvest program can be implemented.

Individual states have the capability to monitor their kangaroo harvest. For example, Queensland has recently established a Macropod Management System that is a new and large computerized database containing information about shooters' records, dealers' records, location of kill, date of kill, sex and species of kill, etc. The capability to track harvest information helps managers assess whether populations are being overharvested. A computerized database in Western Australia, built on harvest data, allows for the analysis of total commercial take by management area, trends in the sex ratio of the commercial take, trends in the average weight of kangaroos in the commercial take, and trends in the commercial take per unit effort (WADCLM 1991a and 1991b). South Australia is collecting, but not yet utilizing in its kangaroo management program, monitoring data about catch per unit of effort, sex ratio of the kill, and average weight of carcass by sex for each species (SANPWS 1991). New South Wales obtains specific information from trappers, chillers, and faunal dealers to determine catch per unit effort, average carcass weight by sex per species, sex ratios of kill, and the distribution of the harvest. This information is available by management zone and on a statewide basis (NSWNPWS 1991a).

The monitoring and assessment of population trends and harvest returns as specified in the approved kangaroo management programs are intended to ensure the conservation of the species.

The State and Commonwealth governments have the capability to police and regulate the commercial take of kangaroos. State governments control illegal trade in kangaroos through regular and random field inspections of shooter and dealer operations and checks on the returns required from them. Law enforcement staff may also respond to public reports of illegal activities. The primary focus in law enforcement activities at the State or Territory level is to detect illegal trade long before material may be proposed for export. This is feasible because of the relatively small number of people involved in the commercial kangaroo industry and the difficulties involved in obtaining and dealing in large quantities of kangaroo meat or skins in a secretive manner. There is also little incentive to become involved in illegal activities when quotas are not being reached (on average only about 70 percent of the

total quotas have been taken in recent years) (ANPWS *in litt.*).

The Commonwealth capability to control illegal trade rests primarily with Customs officers and the Australian Federal Police. Checks on permitted exports of kangaroo products by Customs officers usually are restricted to the inspection of paperwork associated with the export. Customs officers will conduct more detailed inspections and enforcement activities where intelligence indicates that illegal activities may be occurring (ANPWS in litt.). The Wildlife Protection Squad formed within the ANPWS in 1992 is intended to coordinate enquiries/ investigations into allegations of illegal trade in wildlife.

Annual surveys are useful indicators of the comparative health of kangaroo populations over time. Drought is the major natural event that influences the numbers of red and gray kangaroos throughout the CUAs. Annual surveys in New South Wales have been conducted for a sufficient time to indicate the influence of drought on populations. Combined populations of red and gray kangaroos in the CUAs of New South Wales from 1981-1993 (with numbers of animals commercially harvested listed in parentheses) are estimated as follows (population numbers are in millions of animals): 1981=7.05(0.49), 1982=9.40(0.66),1983=5.50(0.40), 1984=2.74(0.23),1985=4.16(0.33), 1986=4.66(0.45),1987=5.43(0.47), 1988=5.50(0.42),1989 = 7.05(0.50), 1990 = 8.55(0.63),1991=9.10(0.86), 1992=7.39(0.79), and 1993=6.45(0.77). The data, unfortunately, provide an imperfect comparison because both census procedures and evaluation areas changed somewhat during the evaluation period. The trend seems clear, however: a population buildup to 1982, a major population reduction measured in 1983 and 1984 in response to the severe drought in summer 1982-1984, a gradual population recovery to 1991, with populations again declining in 1992 and 1993 as the sheep range of New South Wales was again impacted by a severe drought in 1991–2. The commercial harvest (numerically identified in the parentheses, above) is managed as a product of current kangaroo populations, which seem ultimately to be driven by current or recent rainfall conditions. Similar trends may exist for the other states, as well, but the data bases are not as complete or as extensive as those of New South Wales. For example, the data base in Queensland reflects the original use of FW aircraft and more recent use of helicopters in aerial survey efforts,

and aerial surveys have been conducted only at 3-year intervals in Western Australia.

Nevertheless, population information for 1981, 1984, and 1987 (Fletcher, M. et al., 1990) clearly indicates that kangaroo populations subject to harvesting can recover from significant droughts such as occurred in Eastern Australia in 1982–1984.

The major problem in the sheep range is too little herbage and too many herbivores. Efforts to implement a total grazing management policy call for the elimination of feral herbivores and introduced rabbits coupled with reductions in numbers of either sheep and kangaroos, or both.

Skill is required to manage animal populations that tend to respond to fluctuating environmental conditions. For example, New South Wales managed its kangaroo harvest during the drought by monitoring the progression of the drought and transferring harvest quotas from northern management zones where the drought was impacting habitats to more southerly management zones where drought effects were minimal and kangaroo populations were little affected. New South Wales did not reduce the notional quota for the second half of 1992 because the mid-winter 1992 surveys indicated that kangaroo populations remained high. However, New South Wales did hold back and did not allocate 15 percent of the potential harvest quota in case extensive habitat deterioration occurred after the midwinter surveys were accomplished.

The Service finds that State and Commonwealth governments manage kangaroo populations sufficiently well to ensure that red and gray kangaroo populations are not being overutilized in mainland Australia at this time.

C. Disease or Predation

There is no evidence that kangaroos at this time are threatened by disease or predation. Predation by dingos may have been an important limiting factor before the arrival of Europeans. Dingo predation has been severely curtailed to enhance sheep husbandry, and kangaroos have incidentally benefitted from this action. Mortality of red and gray kangaroos, believed caused by an unidentified post-flood agent, was observed in southwestern Queensland following the April 1990 floods. The impact was short-term (ANPWS 1990), however, as regenerating vegetation stimulated increases in subsequent kangaroo populations.