

holes and along cracks to bask in the sun and molt.

The seasonal distribution of ringed seals in the Beaufort Sea is affected by a number of factors, but a consistent pattern of seal use has been documented since monitoring began over 20 years ago by using aerial surveys. Seal densities have historically been substantially lower in the western than the eastern part of the Beaufort Sea (Burns and Kelly, 1982; Kelly, 1988). Frost *et al.* (1999) reported consistently lower ringed seal densities in the western versus eastern sectors they surveyed in the Beaufort Sea during 1996, 1997, and 1998. The relatively low densities appear to be related to much of the area occurring between the shore and the barrier islands, which is generally shallow. This area of historically low ringed seal density is also the focus for much of the recent on-ice seismic surveys.

The estimated number of ringed seals likely to be in the 846-mi² (2,190-km²) activity area is less than 3,900 animals. This estimate is based on a density of 1.73 seals per km², which was derived from the most current aerial surveys of the region. Frost and Lowry (1999) reported an observed density of 0.61 ringed seals per km² on the fast ice from aerial surveys conducted in spring 1997 of an area (Sector B2) overlapping the activity area, which is in the range of densities (0.28–0.66) reported for the Northstar project from 1997 to 2001 (Moulton *et al.*, 2001). This value (0.61) was adjusted to account for seals hauled out but not sighted by observers (x 1.22, based on Frost *et al.* (1988)) and seals not hauled out during the surveys (x 2.33, based on Kelly and Quakenbush (1990)) to obtain the density of 1.73 seals/km². This estimate covered an area from the coast to about 2–20 miles beyond the activity area, and it assumed that habitat conditions were uniform and, therefore, it was not adjusted for water depth. Since a high proportion (≤ 60 percent) of the activity area is within water less than 3 m (9.8 ft) deep, which Moulton *et al.* (2001) reported for Northstar supported about five times fewer seals (0.12–0.13 seals/km²) than the 0.61 seals reported by Frost and Lowry, the actual number of ringed seals is probably closer to slightly more than half of the 3,900 seals or about 2,000 seals. This estimate is calculated as follows: (1) 1,314 km² x 0.13 x 1.22 x 2.33 = 486 seals in area having water depths of 0–3 meter (60 percent) in activity area; (2) 876 km² x 0.61 x 1.22 x 2.33 = 1,519 seals in area having water depths over 3 meters (40 percent) in activity area; and (3) combining the two numbers gives an estimate of 2,005 seals

or approximately 2,000 for the entire activity area. Observed densities of ringed seals reported over 15 years ago in the region of the activity area from 1985 through 1987 (0.85, 1.09, and 1.11 seals per km²) were not used in this analysis, since an estimate was available within the last five years (Frost and Lowry, 1999).

The bearded seal inhabits the Bering, Chukchi, and Beaufort seas (Burns and Frost, 1979). Numbers are considerably higher in the Bering and Chukchi seas, particularly during winter and early spring. Early estimates of bearded seals in the Bering and Chukchi seas range from 250,000 to 300,000 (Popov, 1976; Burns, 1981). Reliable estimates of bearded seal abundance in Alaska waters are unavailable. Since there is no evidence of a decline in the population, the population is presumed to be healthy. Bearded seals are generally associated with pack ice and only rarely use shorefast ice (Burns and Harbo, 1972). Bearded seals occasionally have been observed maintaining breathing holes in annual ice and even hauling out from holes used by ringed seals (Mansfield, 1967; Stirling and Smith, 1977). However, since bearded seals are normally found in broken ice that is unstable for on-ice seismic operation, bearded seals will be rarely encountered during seismic operations.

There are no reliable estimates for bearded seals in the Beaufort Sea or in the activity area (Angliss *et al.*, 2001), but recent surveys show that few bearded seals inhabit the activity area during December through May. An indication of their low numbers is provided by the results of aerial surveys conducted east of the activity area near the Northstar and Liberty development sites. Three to 18 bearded seals were observed in these areas compared to 1,911 to 2,251 ringed seals in the spring of 1999 through 2001 (Moulton *et al.*, 2001; Moulton and Elliott 2000; Moulton *et al.*, 2000). Similarly small numbers of bearded seals would be expected to occur in the activity area, where habitat is even less favorable because of the high proportion of shallow water area.

Potential Effects on Marine Mammals

NMFS and CPA anticipate that only small numbers of ringed seals and, if encountered, very small numbers of bearded seals will be affected. Any takes that occur would result from short-term disturbances by noise and physical activity associated with on-ice seismic operations. While operations have the potential to disturb and temporarily displace some seals, any impacts will likely be confined to small numbers of

seals in the immediate vicinity of the activities.

Burns and Kelly (1982) concluded that displacement of ringed seals in close proximity (within 150 m (492 ft)) to seismic lines does occur, and ringed seal pupping in shorefast ice habitats within this distance of an on-ice shot line in favorable ringed seal habitat are likely to be disturbed by vibroseis operations. However, considering (1) the limited area of seismic surveys, (2) the non-random distribution of ringed seals, (3) avoidance by seismic operator of optimal seal habitat (i.e., areas of extensive pressure ridging and snow accumulation) due to safety and operational constraints, (4) occurrence of most of the on-ice seismic surveys in shallow and near shore waters where ringed seal densities are low, (5) the relatively large size of the ringed seal population in the Beaufort Sea and throughout Alaska, and (6) the lack of evidence of on-ice seismic activity negatively affecting the reproductive viability or distribution of the ringed seal population, the disturbance is not likely to have any effect on the ringed or bearded seal populations as a whole.

Aerial survey data collected from 1985 to 1987 and 1997 indicate that ringed seal densities in the fast ice of the region of the activity area as well as among different section of the Beaufort Sea are highly variable among years (Frost *et al.*, 1999). The reported inter-annual variability in overall average density during these years in the region of the activity area was 0.61 to 1.11 seals per km². Based on an estimated rate of temporary displacement determined by Burns (1981) of 0.6 ringed seals per nm² (0.52 per mile) of area subjected to seismic activity, a maximum of 832 seals could be displaced from 1,600 mi (2,575 km) of seismic surveys assuming a uniform distribution. However, since the distribution is not uniform and most of the activity area is marginal habitat for ringed seals, considerably fewer seals would likely be temporarily displaced by the seismic operations. Furthermore, the proposed seismic operations will be concentrated in 143 mi² (378 km²) or about 17 percent of the 846 mi² (2,190 km²) activity area. Consequently, a more accurate maximum limit of the potential take of ringed seals by the proposed seismic operations is 340 (17 percent x 2000) seals, which would be considerably higher than any incidental take of seals in birthing lairs.

Pup mortality could occur if any of these animals were nursing and displacement was protracted. However, due to mitigation measures undertaken by the industry and because it is highly