, 46(4), 2010, pp. 1325–1329
Wildlife Disease Association 2010

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tively. Radio-tracking flights began within

surgery, four of 47 (8%) birds died during recovery, and no birds died in the initial 2 wk after release. All four of the birds that died during the 2-wk post-release period and four of the seven birds that died during recovery had been captured in unoiled areas of PWS.

Mean mortality rates during surgery and recovery for the biopsied birds in this study (4.5 6 1.6%) were not significantly different (5 0.16) from the mortality rate (2.3 6 0.9%) for ducks that were implanted but not biopsied (Mulcahy and Esler, 1999). During the 2-wk postoperative period, mortality rates for birds that had liver biopsies (2.7 6 1.3%) did not significantly differ (5 0.75) from the rate (3.4 6 1.1%) reported for ducks implanted but not biopsied (Mulcahy and Esler, 1999).

Five of seven free–ranging birds that died during recovery in 2001 and 2002 had survived anesthesia and surgery before developing identical signs and dying. Once the isoflurane was discontinued and the birds were repositioned to ventral or ventrolateral recumbency, they became severely dyspneic, including increased respiratory effort, open-mouthed breathing, and raspy respiratory sounds. Returning the birds to dorsal recumbency did not relieve the dyspnea. Dyspneic birds were given oxygen by facemask or by endotracheal tube for up to 45 min for birds that survived (three in 2001 and one in 2002) or until death occurred. Two additional birds died during recovery in 2001 and 2002 without signs of dyspnea or other gross abnormality. No obvious causes of death were found on necropsy of birds that died during recovery. There were no signs of hemorrhage at the biopsy sites, and no accumulation of blood was found in the coelom. None of the post-release birds that died were recovered.

Gelatin foam was applied to the cut edge of the livers that showed any bleeding. In 2000 gelatin foam was applied to the livers of 17 of 55 free–ranging ducks. With experience, gelatin foam was applied more sparingly and was used in only one free–ranging duck each year in 2001 and 2002. Gelatin foam was used only once in captive ducks.

The mean weight of the birds sampled in PWS was 579 6 41 g (range: 372–688 g); the mean weight of the captive birds at surgery was 543 6 35 g (range: 438–601 g). The mean weight of all biopsy samples was 62.4 6 35.6 mg (range: 10.6–181.4 mg). The mean weight of the biopsy samples was 0.01% of the mean weight of the

when captured in the winter and implanted with transmitters (Mulcahy, unpubl. data).

The stress experienced by wild birds under winter conditions makes some of them poor candidates for capture, anesthesia, and surgery (Stoskopf et al., 2010). The overwinter mortality of Common Guillemots ( ) was effectively doubled by the additive effects of oil spills and environmental conditions (Votier et al., 2005). Perhaps reflecting the controlled captive environment, none of the captive Harlequin Ducks died following biopsy.

Mortality rates of free-ranging Harlequin Ducks during and following liver biopsy were not different from those reported for Harlequin Ducks without liver biopsies (Mulcahy and Esler, 1999). Although all surgical procedures result in a risk of mortality, we found that taking a liver biopsy did not markedly increase this risk over that incurred during radio implant surgeries. Therefore, we consider this an appropriate and relatively safe method of nonlethally obtaining tissue samples for contaminant analysis or other purposes.

We thank the crew of the M/V for field logistics. James Leach and Mark Mitchell provided additional surgical services. Kim Trust and Bruce Woodin supplied the weights of the liver biopsies. Studies were approved by the Institutional Animal Care and Use Committees at the Alaska SeaLife Center and Simon Fraser University. This study was supported by the Oil Spill Trustee Council; the authors' conclusions are their own and do not necessarily reflect the views of the Trustee Council. Mention of trade names does not constitute government endorsement of products.

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