tant prey for larval Pacific Giant (*Dicamptodon ensatus*) and Cope's salamanders (*Dicamptodon copei*) and Red-legged Frogs (*Rana aurora*) (Bury 1968; Jones and Raphael 1998). Observations of garter snakes (*Thamnophis* spp.) (Karraker 2001) and Cutthroat Trout (*Salmo clarki*) depredating Tailed Frogs have also been previously reported (Daugherty and Sheldon 1982). We found only one instance in the literature where American Dippers were cited as being a potential predator of Tailed Frogs, in Butler Creek, Montana (Daugherty and Sheldon 1982). However, it was not clear whether those authors actually observed dippers feeding on Tailed Frogs. Given that the Tailed Frog is a provincially blue-listed (vulnerable) species in British Columbia and of special concern in the national COSEWIC listing, documentation of these rare observations is important.

Tailed Frogs are endemic to the Pacific Northwest. They range from British Columbia south to California, occupying western mountain streams and humid forests throughout a 15-20 year lifespan (Daugherty and Sheldon 1982). Larvae take from 1 to 4 years to metamorphose into adults in cool fast streams (Bull and Carter 1996). Their distribution directly overlaps that of the American Dipper, which occupies the same habitat and geographic range. Both species are considered sensitive to environmental impacts in mountainous watersheds from anthropogenic sources (Nussbaum et al. 1983, Kingery 1996). Given that these two species occupy the same habitat and geographic range, American Dipper predation of Tailed Frogs may be more widespread than previously acknowledged.

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Piping Plover, *Charadrius melodus,* egg viability after seawater immersion

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Four observed nest histories indicate Piping Plover eggs are able to survive immersion in seawater, but little is known regarding their hardiness. As Piping Plover nests are often exposed to tidal flooding, their eggs may be relatively resistant to inundation by seawater. Therefore, we suggest that replacing eggs recently flooded or washed out of nests is a viable option for the recovery of individual nests.

Key Words: Piping Plover, *Charadrius melodus melodus*, flooding, high tide, hatching success, viability, Prince Edward Island, Nova Scotia.

The Atlantic Coast population of Piping Plover (*Charadrius melodus melodus*) is listed as *Endangered* in Canada and *Threatened* in the United States (Goossen et al. 2002; U.S. Fish and Wildlife Service 1996). Nesting Atlantic coast Piping Plovers prefer flat coastal beaches with sand and pebble substrate (Boyne and Amirault 1999; Burger 1987; Cairns and McLaren 1980). The male scrapes a shallow depression in the substrate between the mean high water mark and the edge of adjacent dunes or vegetation (Burger 1987; Cairns 1982; Haig 1992). The young hatch after approximately 28 days and leave the nest within hours of hatching (Cairns 1982; Haig 1992). Nesting areas are often flooded by storm-induced overwashes (Cairns and McLaren 1980) and high water levels destroy many plover nests each season (Sylvester 1991).

Four cases in which flooded Piping Plover eggs remained viable were documented during the course of regular monitoring at Prince Edward Island National Park and in southern Nova Scotia. The following nest

histories confirm the viability of flooded eggs.

Case 1. On 29 May 1992, a nest at Cavendish Sandspit in Prince Edward Island National Park (46.5036ºN, 63.4408ºW) was completed with four eggs. On 5 June, the nest was submerged by a high tide. Both adults were present but not searching for their eggs or vocalising excessively. Their eggs were removed from the nest, temporarily replaced with clay eggs and returned to the nest later that day. The shells that had lined the nest were covered by wet sand and some water still remained in the nest. After a brief period, one of the adults returned to the nest and began to incubate and the second adult arrived at the site shortly thereafter. On 24 June, four chicks hatched after 26 days of incubation. The four chicks were considered to have fledged on 14 July.

Case 2. On 3 June 1999, a nest at Cavendish Sandspit (46.5028ºN, 63.4322ºW) was completed with four eggs. On 17 June, this nest was flooded and the eggs were found approximately 1 m from the nest in 10 cm of water. Both adults were present and appeared agitated. The real eggs were removed and clay eggs were placed in the nest. One severely cracked egg was discarded and the three undamaged eggs were returned to the nest once the water receded. One chick hatched on 30 June, and a second was observed on 1 July. The remaining egg was abandoned. Only one chick survived to fledge and it was banded on 12 July. This chick was recaptured as a breeding male on the same beach in 2001.

Case 3. On 17 June 1999, a nest with three eggs at Cavendish Sandspit (46.5047ºN, 63.4483ºW) was flooded without damage to the eggs. The eggs were found under 10 cm of water, more than 1 m from the nest. They were replaced with clay eggs. An adult was observed incubating the clay eggs approximately 1.5 hours later. The real eggs were then replaced and both adults returned within 30 minutes. Only one adult was observed on subsequent visits and the nest was considered abandoned on 20 June. The eggs were collected on 22 June, candled, found to be viable and placed in an incubator. The eggs were candled again on 30 June, when further growth and movement was observed in all 3 eggs. The eggs were successfully fostered to another Piping Plover pair on 3 July, but were taken by a predator on 4 July. The eggs from this nest were not only flooded, but endured a 24-48 hour lapse in incubation without any apparent decrease in viability.

Case 4. A nest with three eggs was discovered on 12 June 2001 at Sebim Beach in Sand Hills Provincial Park, Nova Scotia (43.5311°N, 65.5580ºW). The full clutch remained on 25 June, but the high tide had completely overwashed the nest and the sand remained wet. Only two eggs remained on 11 July, and incubation was confirmed on 13 July. One abandoned egg remained in the nest on 16 July. On 18 July, a recently hatched chick (<5days of age) and one adult were observed. The development timeline indicates a protracted incubation period of at least 32 days. Neither chick nor adults were observed after 18 July, and the rearing period was too short for the chick to have fledged successfully.

No information is available on the resistance of Piping Plover eggs to submersion (Haig 1992). Ward and Burger (1980) found that some embryos of Herring Gull (*Larus argentatus*) eggs could remain viable after immersion in cold seawater. As Piping Plover eggs have long been exposed to selection due to tidal flooding, they may be relatively resistant to the effects of inundation (Ward and Burger 1980). Piping Plovers exhibit strong parental tenacity to incubate and tend eggs (Prellwitz et al. 1995) and it is likely that their quick resumption of incubation of eggs after flooding increases the probability of successful hatching. These nest histories confirm that some Piping Plover embryos can survive immersion in seawater, and that replacing eggs washed out of recently flooded nests will increase the survival of individual clutches.

Protracted incubation periods due to nest cooling have been recorded for Piping Plovers and other shorebirds (Cairns 1982). Therefore, eggs believed to have been immersed in seawater, but still present in the nest cup, should not be removed as long as the adults continue to incubate and the incubation period is shorter than 40 days.

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