Pigeon guillemots (*Cepphus columba*) are cliff-nesting alcids whose range extends from California to Alaska and into Russia (Sowls 1978). Dense regional populations that breed in the Farallon Islands, CA (Nelson, Ainley), Vancouver Island in British Columbia (Ewins), and Naked Island, AK (Kulets 1983 and others) have been the focus of numerous ecological studies, forming the foundation of our knowledge about the species to date. Insights can also be gleaned from research on two closely related species, spectacled guillemots in X () and black guillemots that have been studied in locations across the Northwest Atlantic Ocean and North Sea (Asbirk 1979; Petersen 1981). An estimated 40% of chicks survive to reach breeding age around 3-5 years (Nelson 1991; Ewins 1993) with an estimated 80% survival rate for adults (Nelson 1991) and a total life expectancy of 8-9 years (Cormack 1964; Ewins 1993). Little is known about winter habitat or distribution, but beginning in late spring, pigeon guillemots concentrate around colony sites to nest in cliff burrows along rocky shorelines spanning the outer coast, inland areas, and offshore islands.

While pigeon guillemots share many similarities with their alcid relatives, they also have unique life history traits that affect when and how many individuals are at the colony and how reliably they can be detected and counted when and if they are there. Namely, that the level of activity and the number of birds at a colony is governed by both seasonal and daily cycles. At the seasonal level, male birds arrive at the colony first to stake out burrow territory (Nelson 1987). Non-breeding individuals are also present in higher numbers at the beginning of the season (approximately 30% of total) and gradually disperse once nesting begins (Drent 1965). Eggs incubate for an average of 30 days (Drent 1965) with both sexes tending the nest (Cairns). Once the egg hatches, adults alternately deliver food until chicks fledge after 33-45 days (Thoreson & Booth; Drent 1965; Carins; Vermeer 1993; Oakley & Kuletz 1996), which is difficult to observe as it generally occurs at night. Peak prey deliveries generally occur in the early mornings and evenings, often corresponding to optimal foraging periods based on tidal fluctuations (Ainley & Lewis 1972; Petersen 1981; Vermeer et al. 1993). Unlike other alcids, pigeon guillemots (particularly experienced breeders) often lay double clutches (where a second “beta” egg is laid ~4 days after the initial egg), an ability that likely stems from nearshore foraging[[1]](#footnote-1) (Winn 1950; Drent 1965) on demersal species with predictable distributions rather than lipid-rich pelagic species (Broadstreet & Brown 1985; Cairns 1981; Cairns 1987; Emms & Verbeek 1991; Gaston & Jones 1998; Golet et al 1998; Golet 2000; Wanless 2005).

Pigeon guillemots are not unique in that their demographic rates and reproductive cycle are inextricably linked to prevailing environmental conditions that influence spatio-temporal prey availability. Research suggests that oceanographic variability can impact not only reproductive success and timing, but adult survival and overall population dynamics. Pigeon guillemot reproductive success in the Farallon Islands has been found to be lower in El Niño years (Ainley & B 1990; Ainley 1990) and lower chick growth rates and reduced brood size have coincided with years of lower prey abundance in British Columbia and (?) (Vermeer 1993; Piatt 2003). Changing prey availability due to a shift in the Pacific Decadal Oscillation index coincided with a notable declining in guillemot abundance in the Bering Sea and Gulf of Alaska in the (1990s?) (Litzow et al. 2002). Similarly, Veit & Manne (2015) found that the abundance of black guillemots in the Northeast U.S. correlated with the North Atlantic Oscillation. Guillemot responses to environmental variability are complex and nuanced (Burger 2003; Irons 2008), but one thing is clear: oceanographic conditions matter and can affect everything from nest initiation and attendance to chick provisioning and fledge weights (Nelson 1987; Ainley & B 90).

Pigeon guillemots are one of only three alcids that nest in Puget Sound and despite having been identified as an indicator species for the region, little research has been done on the demographics of local populations. Pigeon guillemots are more concentrated in eastern Juan de Fuca and central and northern Puget Sound (Nysewander et al. 2005), but their patchy distribution (Ewins 1994; Burger 2008) has made estimating abundance trends difficult. Though some seabird species in Puget Sound have declined in recent decades (Anderson et al. 2009), survey counts and model estimates suggest that abundance trends have remaining relatively constant since 2000 (Gaydos & Pearson 2011; Ward et al. 2015; Vilchis et al 2015; Bishop et al. 2016). Developing an integrated population model framework that accounts for environmental variability and produces updated abundance and survival estimates is central to monitoring the resilience of this indicator species to ongoing changes in occurring throughout the region.

Some basics:

* Not many MR datasets

Extras:

~~Research has shown that it is ultimately the prey delivery rate rather than prey nutrient quality that leads to higher chick survival and fledgling weight, which suggests that the benefits of targeting predictably-distributed demersal prey species outweigh the potential benefits of targeting pelagic species with higher lipid content.~~

Survival based on hatch date? (Harris 92)

Survival (adult) similar to black gill but lower than other alcids? (Nelson 91)

1. Allows higher delivery rates and delivery of larger prey items (Carins 1987; Bergman 71?). [↑](#footnote-ref-1)