

AVIAN NEST SURVIVAL IN COASTAL FORESTED BUFFER STRIPS ON PRINCE OF WALES ISLAND, ALASKA

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Abstract. In an effort to provide wildlife habitat and link blocks of forested habitat, coastal forested buffer strips in the Pacific Northwest are managed to mitigate effects of fragmentation that result from timber harvesting adjacent to a coastline. We examined the effect of coastal forest buffer strip width on avian nest survival on Prince of Wales Island, Alaska, in 2003 and 2004. We established nest monitoring plots in two buffer width treatments, narrow (<250 m, $n = 4$) and wide (>350 m, $n = 3$), and monitored a total of 142 nests of six species: the Pacific-slope Flycatcher (*Empidonax difficilis*), Chestnut-backed Chickadee (*Poecile rufescens*), Winter Wren (*Troglodytes troglodytes*), Swainson's Thrush (*Catharus ustulatus*), Hermit Thrush (*Catharus guttatus*), and Varied Thrush (*Ixoreus naevius*). We modeled and compared the daily survival rate (DSR) of each species in both buffer width treatments. Point estimates for DSRs were slightly higher within wide buffers, but confidence intervals overlapped for all species. Overall, Pacific-slope Flycatchers had the highest nest success (87%) and Varied Thrushes had the lowest (22%). In addition, we used an information-theoretic approach to examine support for hypotheses concerning the effects of edge on nest survival of the Hermit Thrush, the only species for which we had sufficient data. Hermit Thrush nest survival was negatively affected by proximity to the coastline. Predators associated with the productive intertidal zone likely increase the predation risk of Hermit Thrush nests located near the coast.

Key words: Alaska, *Catharus guttatus*, edge effects, forest management, nest survival, Prince of Wales Island, Tongass National Forest.

Supervivencia de Nidos de Aves en Franjas Costeras Boscosas de Amortiguamiento en la Isla Príncipe de Gales, Alaska

Resumen. Con el propósito de proveer hábitat para la fauna silvestre y conectar bloques de bosque, se manejan franjas costeras boscosas de amortiguamiento para mitigar los efectos de la fragmentación que resultan de la cosecha de madera en zonas adyacentes a la línea costera en la región noroeste del Pacífico. Examinamos el efecto del ancho de las franjas costeras boscosas de amortiguamiento sobre la supervivencia de nidos de aves en la isla Príncipe de Gales, Alaska, en 2003 y 2004. Establecimos parcelas de monitoreo de nidos considerando dos anchos de franja de amortiguamiento, angosto (<250 m, $n = 4$) y ancho (>350 m, $n = 3$). Monitoreamos un total de 142 nidos pertenecientes a seis especies: *Empidonax difficilis*, *Poecile rufescens*, *Troglodytes troglodytes*, *Catharus ustulatus*, *C. guttatus* y *Ixoreus naevius*. Modelamos y comparamos la tasa de supervivencia diaria de los nidos (TSD) para cada especie en ambos tratamientos de ancho de franja de amortiguamiento. Los estimados de la TSD fueron ligeramente mayores en las franjas anchas, aunque los intervalos de confianza se sobrepusieron para todas las especies. En general, *E. difficilis* tuvo el éxito de nidificación más alto (87%) e *I. naevius* el más bajo (22%). Además, utilizamos una aproximación basada en la teoría de la información para examinar la validez de diferentes hipótesis concernientes al efecto de los bordes sobre la supervivencia de los nidos de *C. guttatus*, la única especie con suficientes datos. La supervivencia de nidos de *C. guttatus* fue afectada negativamente por la proximidad a la línea costera. Los depredadores asociados a la zona productiva intermareal probablemente aumentan el riesgo de depredación de los nidos de esta especie, que se encuentran cercanos a la costa.

INTRODUCTION

Declines in songbird populations have been associated with decreased forest tract size and increased forest edge (Wilcove 1985, Noss and Cooperrider 1994, Donovan and Flather 2002). Nest predation is the primary cause of nest failure in songbirds

(Ricklefs 1969, Martin 1993). Potential links between nest predation and forest edge have been extensively investigated (Hartley and Hunter 1998, Chalfoun et al. 2002, Batary and Baldi 2004); however, few studies have been conducted in the conifer forests of the Pacific Northwest, and even fewer have examined the potential effects of anthropogenic compared to

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natural edges on nest success (Salabanks et al. 2001, George and Brand 2002, George and Dobkin 2002). Biotic and abiotic differences in adjacent habitats may result in differing levels of predation risk between these two edge types.

Numerous studies in various vegetation types have demonstrated that artificial and natural nests located near forest edges experience higher predation rates than those in the forest interior (Brand and George 2000, De Santo and Willson 2001, Chalfoun et al. 2002, Albrecht 2004). In the Pacific Northwest, timber harvesting has resulted in fragmentation of original old-growth forest and an increase in the amount of forest edge. In an attempt to mitigate the potential negative effects of fragmentation resulting from timber harvesting, land managers have commonly prescribed buffer strips that are set aside from harvest. Forest buffers are intended to provide links between habitat reserves and watersheds, maintain a functional interior forest condition, contribute to overall landscape appearance, and conserve habitat for resident and migratory wildlife (USDA Forest Service, unpubl. data).

The National Forest Management Act requires the U.S. Forest Service to develop an adaptive management plan to ensure the viability of native wildlife populations (U.S. General Accounting Office, unpubl. data). As a result, the U.S. Forest Service has drafted and amended numerous management plans for the Tongass National Forest (U.S. General Accounting Office, unpubl. data). In 1986, an amendment was included to prohibit timber harvesting within 150 m of marine coastlines; in 1997, the management plan doubled the no-harvest buffer zone to 300 m (USDA Forest Service, unpubl. data). Artificial nest studies in coastal redwood (*Sequoia sempervirens*) forests in northern California suggest that nest success is significantly lower within 115 m of natural and anthropogenic forest edges (Brand and George 2000). If similar effects occur in coastal Alaska, birds nesting within coastal buffer strips less than 230 m wide may experience higher predation rates than birds nesting in a wider buffer that offers more forest interior.

Our primary objective was to test for differences in daily nest survival of six forest-bird species (Pacific-slope Flycatcher [*Empidonax difficilis*], Chestnut-backed Chickadee [*Poecile rufescens*], Winter Wren [*Troglodytes troglodytes*], Swainson's Thrush [*Catharus ustulatus*], Hermit Thrush [*Catharus guttatus*], and Varied Thrush [*Ixoreus naevius*]) nesting in coastal buffers of two width classes, <250 m in width ("narrow") and >350 m in width ("wide"). We chose these width classes to represent past and present management prescriptions implemented in our study area. Our secondary objective was to evaluate the effects of distance to and type of edge on daily nest survival; we only had enough data to do this for the Hermit Thrush. We hypothesized that the abundance of predators, predator community, and activity patterns of predators would differ along a marine-forest habitat edge compared to a clearcut-forest habitat edge.

METHODS

STUDY AREA

We conducted this study on Prince of Wales Island, in the Alexander Archipelago of southeastern Alaska, approximately 35 km northwest of Ketchikan, Alaska (56°01'N, 132°51'W). Prince of Wales Island encompasses 6667 km² and ranges in elevation from 0 to 1092 m above sea level. The landscape is characterized by steep, rugged topography and narrow inlets. The dominant plant species are western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), salmonberry (*Rubus spectabilis*), and blueberry (*Vaccinium* spp.). Vegetation on the island is naturally heterogeneous because of mountainous terrain, wetlands, and various small-scale disturbances such as windthrow (Ott 1997). Land ownership on Prince of Wales Island is divided among the federal government (80%), village corporations (14%), state government (3%), and private individuals (2%). The remaining area is freshwater (1%). Between 1920 and 2000, approximately 912 km² of timber, roughly 26% of the productive forest on the island, was extracted from federal lands. Today, the forested landscape at lower elevations, where the majority of timber extraction occurred, is patchy and fragmented (Fig. 1). Buffer strips located along the coastline are

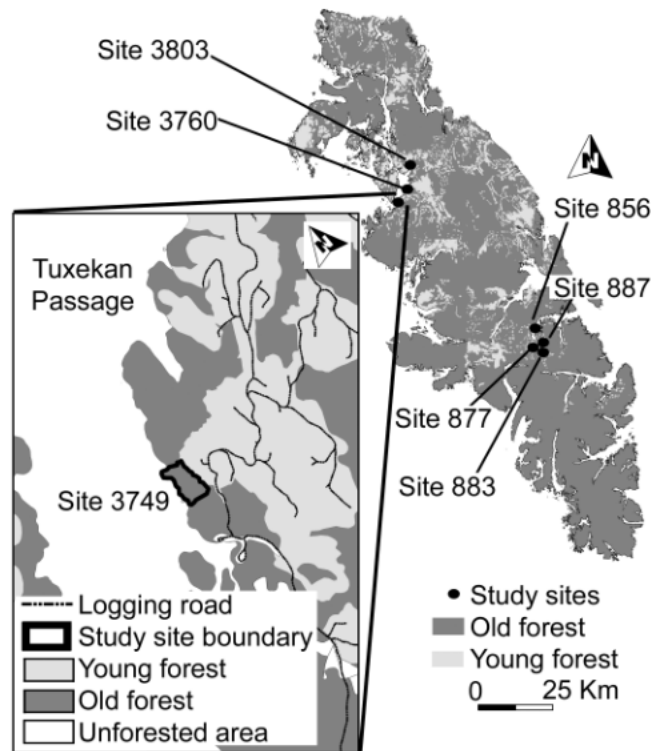


FIGURE 1. Location of study sites on Prince of Wales Island, Alaska. Inset map depicts typical landscape configuration in relation to a narrow coastal forest buffer (<250 m width) study site. Dark gray areas indicate old-growth forest (>150 years old); light grey areas indicate managed young forests (<150 years old); and white indicates unforested areas that include water, rock, and muskeg.

intended to serve as corridors to connect these low-elevation forest patches.

We used U.S. Forest Service vegetation classification maps to estimate coastal buffer strip widths and identified all potential narrow (<250 m) and wide (>350 m) study sites on Prince of Wales Island. We then chose three narrow and four wide study sites based on timber size class (>150 years old), type of harvest adjacent to the site (clearcut), width of adjacent clearcut (>200 m), date of harvest (1983–1997), accessibility (functional road or safe water access), and geographical proximity. Study sites were positioned between a clearcut area and the coastline (Fig. 1). To estimate the area and average width of each study site, we used a handheld Garmin™ (Olathe, Kansas) Rhino® Global Positioning System (GPS) navigator to collect geographic coordinates every 25 m along each study site's boundary. We digitized a continuous line in ArcGIS 9 software (Earth Systems Research Institute, Inc., Redlands, California) from the points collected to delineate each study site. We calculated the width of each forested buffer as the mean of 5–10 width measurements, one every 75 m. Narrow buffers were 183–243 m in width and 9.0–12.0 ha in area and wide buffers were 350–386 m in width and 7.8–18.4 ha in area.

We characterized the landscape surrounding each study site by delineating a 300 ha area centered on each site and calculating landscape metrics using the Tongass National Forest Geographic Information System (GIS) library to obtain classification of vegetation coverage (McGarigal and McComb 1995). Within the 300 ha area, we used ArcGIS 9 software to estimate the percentage of area covered by old-growth forest, young forest (trees with an average dbh <23 cm and <150 years old), and water (Table 1).

All study sites contained typical low-elevation rainforest characteristic of southeastern Alaska (Pojar and MacKinnon 1994). Study sites were bordered by ocean on one side and a clearcut on the opposite side. The two remaining boundaries, which ran perpendicular to the ocean, were within and

connected to forested habitat. We defined the coastline border as a “natural edge” and the clearcut border as an “anthropogenic edge.” We did not include roads transecting our study sites as anthropogenic edges because the forest gap created by roads was narrow (<6 m) and current management guidelines do not preclude road construction within buffer strips. Effects of roads were likely negligible since only one study site contained a road.

NEST SEARCHING

Each year we trained seven field technicians to search for nests using methods described by Martin and Geupel (1993). To standardize search effort among sites, we rotated nest searchers among study sites on a weekly basis and used a ratio of two search hours per hectare per nest searcher. We searched for nests between 05:00 and 14:00 (AST) from May to August in 2003 and 2004. We marked nests inconspicuously with flagging tape and avoided disturbing incubating or feeding adults associated with the nest. We waited for parents to leave the nest before checking nest contents. Low nests were monitored through direct observation of nest contents, while higher nests were checked either with a mirror or camera on an extendable pole or by observing parental behavior at the nest. We monitored and recorded contents of nests every 1–4 days until at least one nestling fledged or the nest failed. Clutch size was recorded as the maximum number of eggs found in completed clutches. We considered nests successful if at least one young fledged from the nest. We assumed nests had failed if nest contents were missing >2 days before the predicted fledging date or if there were obvious signs of predation, such as the nest cup having been torn or the nest having been knocked to the ground.

At the completion of each nesting attempt we collected geographic coordinates and calculated the shortest distance (to the nearest meter) between the nest and both the natural coastline and the anthropogenic harvest edge using the distance command in ArcGIS 9.

STATISTICAL ANALYSIS

We used the logistic-exposure method (Rotella et al. 2004, Shaffer 2004) to estimate daily survival rates (DSR) of nests. We used PROC GENMOD in SAS (SAS Institute 2004) to estimate regression coefficients from the resulting logistic function (Shaffer and Thompson 2007). We back-transformed the estimates produced in the logit scale to obtain an estimate of the DSR and 95% confidence limits. Because we modified the link function for logistic regression to account for the length of each nesting interval, the predicted probabilities represent the probability of a nest surviving one day and are comparable to daily survival estimated by other methods (Mayfield 1975). We compared clutch size and number of young fledged for each species between wide and narrow buffers using PROC GENMOD in SAS (SAS Institute 2004) and specified a Poisson error term.

TABLE 1. Percentage of old-growth forest (>150 years old), young forest (trees with an average dbh <23 cm and <150 years old), and unforested land (including rock muskeg and water) within 300 ha surrounding each of seven study sites on Prince of Wales Island, Alaska, 2003–2004. Study sites were either wide (>350 m) or narrow (<250 m) forested buffer strips bordered by coastline and clearcuts. ‘No data’ indicates land that was not federally owned.

Site	Treatment	Old-growth	Young-growth	Unforested	No data
3803	Wide	52%	16%	31%	1%
3760	Wide	27%	28%	44%	1%
887	Wide	50%	16%	28%	6%
3749	Narrow	31%	25%	42%	2%
856	Narrow	29%	25%	44%	2%
883	Narrow	35%	24%	41%	0%
877	Narrow	18%	44%	38%	0%

We used an information-theoretic approach (Burnham and Anderson 2002) to evaluate support for eight a priori candidate models that represented hypotheses about factors influencing nest survival within coastal forested buffers on Prince of Wales Island. Initially, we intended to examine forest management factors affecting all six species considered in this study, but we only had a sufficient sample of Hermit Thrush nests. We decided against pooling all species due to differences among species in DSR and nest site characteristics (Sperry 2006). Our set of candidate models included only variables directly related to the forest management of coastal buffers. The candidate set included a categorical buffer width effect (<250 m, >350 m), a continuous natural-edge effect (linear distance, in meters, from the nest to the nearest coastline edge), a continuous anthropogenic-edge effect (linear distance, in meters, from the nest to the nearest clear-cut edge), various additive combinations of these effects, a global model with all the explanatory variables, and a constant survival model that included only the intercept. We emphasized additive models to keep the number of parameters low enough for sufficient statistical power given our small sample sizes.

We evaluated the goodness-of-fit of the global model using the Hosmer and Lemeshow (2000) goodness-of-fit test. We estimated the variance inflation factor (\hat{c}) to check for overdispersion by dividing the Pearson χ^2 of the global model by the degrees of freedom. We checked the continuous variables used in the global model for multicollinearity using the Pearson correlation matrix function in NCSS (Hintze 2006).

We compared the candidate models using Akaike's information criterion with a small sample bias adjustment (AIC_c ; Burnham and Anderson 2002). We used the effective sample size to compute AIC_c for all models (Rotella et al. 2004). We ranked models based on the ΔAIC_c values and Akaike weights (w_i ; a measure of model support), and considered model(s) with values of $\Delta AIC_c \leq 2.0$ when making inferences. We used model-averaging to estimate coefficients and variances because no single model received strong support ($w_i > 0.90$; Burnham and Anderson 2002). We converted model-averaged coefficients to odds ratios for ease of interpretation.

RESULTS

In 2003 and 2004 we spent 1434 and 1372 nest-searcher hours in narrow and wide buffers, respectively. We monitored 57 nests of the six study species in 2003 and 85 nests in 2004. In total, we observed 76 nests for 772 days in narrow buffers and 66 nests for 774 days in wide buffers. For all species, neither average clutch size (range: 3–6; all $\chi^2 < 0.1$, all $P > 0.8$) nor average number of young fledged (range: 1–5; all $\chi^2 \leq 0.7$, all $P > 0.4$) differed significantly between the wide and narrow buffers. Combining all species, 82% (117 of 142) of nests successfully fledged young. The primary cause of nest failure was predation; 92% (23 of 25) of nests failed due to predation and 8% (2 of 25) due to abandonment. Overall DSR for all nests monitored was 0.984 (95% CI: 0.976–0.989). Varied Thrush nests had the lowest DSR and Pacific-slope Flycatcher nests the highest (Table 2). DSRs in 2003 (0.980, 95% CI = 0.966–0.989) and 2004 (0.986, 95% CI = 0.976–0.992) were similar. When compared to other studies of nest survival conducted in the Pacific Northwest, DSRs for most species within our study sites were similar or higher (Table 3). The one exception was the lower DSR of Varied Thrush nests (Table 3). Estimated DSR for all nests in narrow (0.982, 95% CI = 0.970–0.989) and wide buffers (0.986, 95% CI = 0.974–0.992) was similar. Although all species showed slightly higher nest survival in wide buffers, differences in DSR between treatments were small compared to differences in DSR among species (Table 2). The binomial probability that all six species would have a higher DSR in the wide buffers was small ($P = 0.02$). The largest difference recorded was for the Varied Thrush, which had 14% lower nest success in narrow buffers compared to wide buffers.

The Hosmer and Lemeshow (2000) goodness-of-fit test indicated that our global model adequately fit our Hermit Thrush data (Pearson $\chi^2_3 = 2.2$, $P = 0.51$). The variance inflation factor (\hat{c}) was 0.99, thus we did not correct for overdispersion. Distance from the coastline was the most important variable in determining nest survival for Hermit Thrush nests: this variable was included in the top two models, which together accounted for >75% of the total Akaike weight (Table 4). The odds of nest survival were 2% greater for each meter

TABLE 2. Number of nests monitored (n) and daily survival rates (DSR, 95% CI) for nests of six species within narrow (<250 m) and wide (>350 m) coastal forested buffers on Prince of Wales Island, Alaska, 2003–2004.

Species	Narrow buffer width			Wide buffer width		
	n	DSR	95% CI	n	DSR	95% CI
Pacific-slope Flycatcher (<i>Empidonax difficilis</i>)	14	0.995	0.964–0.999	4	0.997	0.973–0.999
Chestnut-backed Chickadee (<i>Poecile rufescens</i>)	7	0.976	0.925–0.993	6	0.984	0.947–0.996
Winter Wren (<i>Troglodytes troglodytes</i>)	17	0.990	0.962–0.998	10	0.994	0.972–0.999
Swainson's Thrush (<i>Catharus ustulatus</i>)	9	0.978	0.943–0.992	7	0.986	0.955–0.996
Hermit Thrush (<i>Catharus guttatus</i>)	21	0.986	0.964–0.995	28	0.991	0.978–0.996
Varied Thrush (<i>Ixoreus naevius</i>)	8	0.933	0.862–0.969	11	0.956	0.908–0.979

TABLE 3. Species-specific comparisons between daily survival rates (DSR) of this study and other studies conducted in unfragmented forests of the Pacific Northwest. This study was conducted in wide (>350 m) and narrow (<250 m) forested buffer strips that were bordered by coastline and clearcuts. Number of nests (n) refers to the number of nests monitored in the referenced study.

Species	n	DSR (Reference)	Differences in DSR estimated in this study	
			Within narrow buffers	Within wide buffers
Winter Wren	74	0.993 (Willson and Gende 2000)	-0.003	+0.001
Winter Wren	48	0.986 (George and Brand 2002)	+0.004	+0.008
Winter Wren	143	0.993 (De Santo et al. 2003)	-0.003	+0.001
Swainson's Thrush	55	0.980 (Willson and Gende 2000)	-0.002	+0.006
Swainson's Thrush	21	0.942 (Willson and Gende 2000)	+0.036	+0.044
Swainson's Thrush	23	0.940 (George and Brand 2002)	+0.038	+0.046
Hermit Thrush	24	0.965 (Willson and Gende 2000)	+0.021	+0.026
Varied Thrush	15	0.977 (Willson and Gende 2000)	-0.044	-0.021

increase in distance from the coastline edge, but the 95% CI of the odds ratios for this variable included 1, suggesting that the effect was small (Table 5). Nevertheless, depredated nests were positioned closer to the coastline than successful nests (narrow buffers: successful = 90 ± 43 m from coastline, $n = 98$, depredated = 37 ± 16 m from coastline, $n = 3$; wide buffers: successful = 202 ± 104 m from coastline, $n = 25$, depredated = 107 ± 58 m from coastline, $n = 3$).

DISCUSSION

Our primary objective was to test for differences in daily nest survival of six species in coastal forest buffers of two width classes, narrow and wide. All six point estimates of daily nest survival were higher in wide buffers; however, the confidence

TABLE 4. Model selection results for the eight models used to describe variation in daily survival rate of Hermit Thrush nests on Prince of Wales Island, Alaska, 2003–2004. $\text{Log}_e(\mathcal{L})$ is the value of the maximized log-likelihood function, K is the number of parameters in the model, AIC_c is Akaike's information criterion corrected for small sample sizes and ΔAIC_c is the scaled value of AIC_c , and w_i is Akaike's weight, representing the support for each model. Models are listed from the best- to worst-fitting. Variables used included a categorical buffer width (<250 m, >350 m), a continuous coast edge distance (the linear distance, in meters, from the nest to the nearest coastline), a continuous harvest edge effect (the linear distance, in meters, from the nest to the nearest clearcut border), a global model with all the explanatory variables, and a constant survival model that included only the intercept.

Model	$\text{Log}_e(\mathcal{L})$	K	ΔAIC_c^a	w_i
Coast edge distance	-23.44	2	0.00	0.58
Buffer width + coast edge distance	-23.43	3	2.00	0.21
Global model	-23.40	4	3.97	0.08
Buffer width + harvest edge distance	-24.86	3	4.88	0.05
Harvest edge distance	-26.35	2	5.82	0.03
Constant survival model	-27.57	1	6.24	0.03
Buffer width	-26.98	2	7.08	0.02
Year	-27.40	2	7.93	0.01

^a The AIC_c value for the top model was 50.90.

intervals for narrow and wide buffers overlapped. In addition, both average clutch size and average number of fledglings per successful nest were similar in wide and narrow buffers. A possible reason for these findings is the absence of a primary nest predator, red squirrels (*Tamiasciurus hudsonicus*), on Prince of Wales Island (MacDonald and Cook 1996).

Previous research has identified red squirrels as the most frequent nest predator on other islands and the mainland of southeast Alaska (Sieving and Willson 1998, De Santo and Willson 2001, De Santo et al. 2003). On Prince of Wales Island, where red squirrels are absent, five of the six species monitored had similar or higher DSR than in previous studies conducted in the Pacific Northwest (Willson and Gende 2000, George and Brand 2002, De Santo et al. 2003). Because predation is the primary cause of nest failure for birds (Ricklefs 1969, Martin 1993), absence of these predators likely had profound impacts on reproductive success in our study. In a well-designed experimental study conducted in Arizona, Fontaine and Martin (2006a, 2006b) removed nest predators, including red squirrels, from study sites and documented significantly lower predation rates and higher nest success. In addition, Fontaine and Martin, (2006a, 2006b) detected differences in breeding behavior when predators were removed, indicating that songbirds can perceive reduced predation risk. Based on

TABLE 5. Odds ratios and 95% confidence intervals (95% CI) for explanatory variables based on model-averaged parameter estimates from logistic-exposure models examining daily survival rate of Hermit Thrush nests on Prince of Wales Island, 2003–2004. Confidence intervals reflect both uncertainty in parameter estimates from a given model and uncertainty in selecting that model (Burnham and Anderson 2002).

Parameter	Odds ratio	95% CI
Coast edge distance	1.020	0.995–1.045
Buffer width (wide vs. narrow)	1.040	0.424–2.553
Harvest edge distance	0.999	0.994–1.004
Year (2003 vs. 2004)	0.995	0.966–1.025

our results, nest predation for the majority of the species we monitored was lower, regardless of buffer width, when compared to other studies.

In contrast to most species monitored, nest success for Varied Thrushes in the fragmented landscape of buffers was 32% lower than in contiguous forest tracts of southeast Alaska (Willson and Gende 2000). Fragmentation caused by timber harvesting may have increased the susceptibility of Varied Thrushes to predation by avian predators. In the absence of red squirrels, we speculate that raptors (owls and hawks) were frequent predators of Varied Thrush nests, and in fact we observed a Sharp-shinned Hawk (*Accipiter striatus*) depredate one nest. Previous research has shown a relationship between edges and habitat selection for many raptors that are commonly found in our study sites, including Barred Owls (*Strix varia*; Fuller 1979), Northern Pygmy Owls (*Glaucidium gnoma*; Piorecky and Prescott 2006), and Great Horned Owls (*Bubo virginianus*; Smith et al. 1999). Compared to the other species that we monitored, Varied Thrush nests may be at greater risk of avian predation due to their characteristics. Varied Thrushes build bulky, large diameter nests (15–19 cm) that, on our study sites, were not well concealed (36% average concealment; Sperry 2006) and were placed in the midcanopy (average height = 3.8 m; Sperry 2006). Remeš (2005) demonstrated that badly concealed nests located higher in the canopy were more often depredated by avian predators than by mammalian predators. In addition, the nestling diet of Northern Goshawks (*Accipiter gentilis*) in southern southeast Alaska is comprised mostly of birds (85%), of which 11% is adult Varied Thrushes (Lewis et al. 2006). Thus, Varied Thrushes may be particularly susceptible to predation by raptors and may be negatively affected by forest management actions that result in increased edge.

In contrast, Hermit Thrushes fit the general pattern on Prince of Wales Island, with higher nest success than that reported in previous studies (Willson and Gende 2000). Although lack of red squirrels was likely the primary reason for this finding, we were able to document an interesting relationship between nest survival and distance to the coastline, with decreased nest survival along coastal edges. Our results suggest that the predators responsible for depredating Hermit Thrush nests are associated with the productive intertidal zone. We frequently observed minks (*Mustela vison*) and corvids foraging in the intertidal zone and within the coastal fringe of our study sites (DMS, pers. obs.). With over 17 700 km of coastline in the Tongass National Forest, this link between coastline edge and nest survival should be considered during management decisions pertaining to coastal forest. We did not detect significant effects of anthropogenic clearcut edges on nest survival, highlighting the importance of differentiating between edge types based on adjacent habitat. The abiotic and biotic differences between the coastline and a clearcut likely result in different predator communities and subsequent predation risk.

Although we did not find evidence for significant differences in daily survival rate between wide and narrow buffers, the absence of red squirrels on Prince of Wales Island likely influenced nest survival and highlights the need for further research on interactions between avian nest survival, nest site selection, and predator behavior. Therefore, we emphasize that our results are applicable to Prince of Wales Island only, or other similar ecosystems that lack large numbers of mammalian predators. Prince of Wales Island may provide a refuge for some nesting passerines and affords an opportunity to study the possible divergence in breeding behavior and reproductive strategies in the absence of a regionally abundant nest predator. Further research in coastal buffers on islands with and without predators is needed to better evaluate the effectiveness of varying buffers widths for avian nest success.

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