

Survival and winter site fidelity of Sooty Fox Sparrows on southern Vancouver Island, British Columbia

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Abstract: In the winter of 2012-13, 115 Sooty Fox Sparrows (*Passerella iliaca*) were trapped and banded in southern Vancouver Island, B.C. Intensive searches were made to locate those birds in the winter of 2013-14 and incidental observations of banded birds were made in each of the next four winters. All re-captures and re-sightings were either at the original capture site or in very close proximity indicating strong wintering area site fidelity. The banded birds were 46% adults, a very large difference from the 16% found during fall migration banding at Rocky Point Bird Observatory in Victoria. This suggests that fall migrants are a different population than winter residents of southern Vancouver Island. Adjusted recovery rates over one year were 51% for adult birds, 30% for young, and 40% overall. Because of the intensity of observation and high site fidelity, it is suggested that these be considered estimates of true survival.

Key Words: Sooty Fox Sparrow, *Passerella iliaca*, Vancouver Island, true survival, winter site fidelity, age ratio, banding, geolocators.

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Introduction

Rocky Point Bird Observatory (RPBO) investigated migration and wintering of Sooty Fox Sparrow (*Passerella iliaca*), a winter visitor to Victoria, B.C. Birds were trapped at numerous locations throughout Greater Victoria and near Nanaimo in the winter of 2012-13 and recaptured the following winter. Sparrows were banded and aged as part of a larger migration study using geolocators (Fraser *et al.* 2018). This provided an opportunity to assess survival and winter site fidelity among Fox Sparrows in southern Vancouver Island.

Methods

In the winter of 2012-13 RPBO trapped, banded, and determined age for 115 Fox Sparrows in southern Vancouver Island (at a variety of sites around Greater Victoria and Nanaimo). Geolocators were attached only to birds hatched at least two summers before that winter, which are termed here as “adult” birds¹. Birds were trapped using passive ground traps baited with seeds. Age was determined according to Pyle (1997) based on

plumage and feather wear. Almost half of all birds trapped (46%) were “adult” birds. Measurements were taken of all Fox Sparrows trapped including weight, wing chord, tail length, and bill dimensions. One re-trix was removed from selected birds and used for genetic gender determination.

As it was necessary to recover as many birds as possible the following winter, the focus was to trap in gardens with established feeding stations where Fox Sparrows were commonly observed. Owners of selected sites agreed to observe birds at their feeders and immediately report any banded Fox Sparrows. Trapping in private gardens was done in January with a team of up to eight volunteers; a bander and a geocator installer were at a central site, while other team members checked traps located in gardens in the surrounding area.

Three public locations were also used by RPBO: Royal Roads University (as part of RPBO’s annual banding workshop), Pedder Bay Marina (a fall migration monitoring site), and Swan Lake Nature Sanctuary, where large numbers of Fox Sparrows are attracted to feeders near the Nature House. The three public sites were trapped mainly in March. Their intended purpose was to establish a control group of birds that were not fitted with geolocators. However, some of these birds

¹ Note that, strictly defined, in January there are only after-hatch-year (AHY) birds. As we were trapping birds in winter (spanning two calendar years) “adult” is used here to mean a bird that was not hatched in the previous summer.

had a dummy geolocator installed with the purpose of determining if operation of the geolocator had an effect on migratory success.

Based on results reported by Sandercock and Jaramillo (2002) it was decided to target only adult birds for installation of geolocators, as they are more likely to return to wintering sites than are young birds. As the age of Fox Sparrows cannot be determined unless the bird is in the hand (Pyle 1997) the team banded all birds trapped. Colour bands were attached to help distinguish targets for recapture. Yellow bands were used for geolocator carrying birds, white for other adult birds and no colour band for juvenile birds. As some of the colour bands were lost, recapture of target birds was attempted whenever any banded Fox Sparrow was observed with or without a colour band. To help identify target birds (with geolocators), bands on observed birds were photographed by volunteers with high resolution equipment. Again, this was mostly accomplished in January of the following year.

Fox Sparrows seemed to become wary of the passive ground traps used for initial capture, so a combination of other trapping methods was used for recapture (ground traps, mist nets, a modified Heligoland trap, and, most successfully, human triggered drop traps). Recapture focussed on subject birds in the geolocator study. Other adult and juvenile birds were recovered only incidentally. In subsequent winters, no attempt was made to recapture banded Fox Sparrows. However, observations of banded Fox Sparrows were recorded and when possible band numbers were read from photographs.

Results

Adult birds were trapped at all but one of the 21 banding sites. Geolocators were deployed on adult birds at 16 sites. In total, 53 of the 115 birds (for which age was determined) were adults (46%) and 62 were young (54%), (Table 1).

In the winter of 2013–2014, 15 of the 30 geolocator carrying birds returned (50%). Whenever a potential geolocator carrying bird was observed in the 2013-14 winter, considerable resources were deployed in an attempt to capture the bird and recover the geolocator. Given the intensity of these recovery efforts it is unlikely that a geolocator carrying bird returned to the banding sites without detection. All geolocator carrying birds were re-captured at the same locations in which they were banded. Nearly all recoveries were at feeder sites

Banded birds were observed in the winter of 2013-2014 at 18 of the 21 banding sites. Of the 53 adult birds banded in 2012–2013, 20 birds (38%) were observed the following winter (Table 1). In addition, of 62 young birds banded, 15 (24%) were observed or trapped the following winter. Overall the return rate from the original banded birds was 30%. The control group birds were all banded at Swan Lake Nature Sanctuary. A total of 19 birds were banded, 10 adult and nine young birds. Of these birds, six (four adult, two young, when banded) were observed the following winter.

There has been incidental observation of banded birds in each of the next five winters (Table 1), though observation effort has been variable. In the winter of 2015-2016 (the third winter since banding), nine banded Fox Spar-

Table 1. Fox Sparrows re-trapped or observed on southern Vancouver Island in winters subsequent to 2012–2013.

Year banded	Adults ¹ Geolocator	Adults Other ^{2,5}	Young	Total ⁶	Adults ⁷	
					Predicted	Observed
2012–2013	30	23	62	115		
Year recaptured /observed						
2013–2014	15	5	15	35	19	20
2014–2015	3	1	1	5 ³	10	
2015–2016	1	1	1	9 ⁴	5	
2016–2017	2	1	2	5	3	3
2017–2018	1	1	2	4	1	2
2018–2019	-	1	-	1	1	1

¹ Age class at time of banding is used for subsequent years. Adults are birds hatched in 2011 or earlier.

² Other includes adult birds with “dummy” backpacks, and adult control group birds

³ No records available for winter of 2014–2015 for Victoria.

⁴ Band numbers not available for Victoria birds for 2015-2016, therefore age at time of banding not available.

⁵ Includes one bird banded at Pedder Bay (March 2013), recaptured during fall migration monitoring 2014, 2015, 2016 and 2018.

⁶ Note that the total for 2013–2014 includes one bird not observed that year but observed the following two years. Also the totals for 2015–2016 and 2016–2017 include one bird not observed in those years but observed in 2017–2018.

⁷ The number of birds surviving from the original 37 (adjusted) assuming a corrected return rate of 51% for adult birds (see text). No observations were available for 2014–2015 or 2015–2016.

rows were observed in the study area. Two of the birds observed in that winter were adults when first banded, and were therefore on (at least) their fifth trip south. In the winters of 2016–2017 and 2017–2018 three banded birds were observed. One of these birds had not been seen since the winter of 2013–2014 and has been added to the survival totals for the intervening years. Another bird, adult when first banded, was recaptured during fall migration monitoring at Pedder Bay in October 2018, on its (at least) eighth trip south from the breeding areas in northwestern B.C. and coastal Alaska.

Discussion

Site Fidelity

All re-captures and re-sightings were either at the original capture site or in very close proximity, indicating strong wintering area site fidelity. Given the intensity of observation effort made at, and around, the initial capture sites it seems unlikely that banded birds remained undetected if they were in the vicinity. It is possible that some other birds survived the summer following initial capture and spent the next winter somewhere other than their initial capture site.

Our study design was based on the concept of winter site fidelity. Fidelity to breeding sites is affected by genetic considerations related to mate selection, and by ecological factors such as local knowledge of food and predator dispersion. In contrast, fidelity to wintering sites should be determined by ecological factors alone, unless pairing occurs at non breeding areas, as in waterfowl (Robertson *et al.* 1998). For at least some migratory land birds, site attachment is stronger at wintering sites than at breeding areas (Holmes and Sherry 1992).

Age Ratios

Adult birds wintering on, or migrating through, southern Vancouver Island have survived at least one previous northward migration to their breeding areas. During 17 years of fall migration banding at RPBO, more than 2,200 Fox Sparrows were captured, of which 16% were after hatch year (AHY) birds, which is typical for all species captured overall (RPBO records). While the ratio of hatch year (HY) birds to AHY birds varies with the productivity of the breeding season, normally young birds are expected to outnumber breeding adults. However, the age ratio of birds trapped in the winter of 2012–13 was 46% adult birds (for Victoria area birds the ratio was 50%), a very large difference from the fall migration ratio at RPBO.

The most likely cause of the difference in age ratios is that the majority of birds trapped in the fall at RPBO are not winter residents in the Greater Victoria area and are from different populations. Only one bird was captured

during the winter at the RPBO fall migration monitoring site, in March 2013, despite hundreds of Fox Sparrows being trapped there during fall migration in 2012. This wintering bird was recaptured three more times during subsequent fall migrations. These results suggest there is only very limited overlap between through-migrants and winter resident populations. It is concluded that RPBO migrants are a different population than winter residents of southern Vancouver Island.

Survival

Annual return rates to a wintering or breeding site derive from the combination of four probabilities: true survival, site-fidelity, annual variation in local site use or breeding propensity, and detection (Sandercock and Jaramillo 2002). Using these four probabilities, Sandercock and Jaramillo (2002), in the only published study of winter survival of Fox Sparrows, conclude a numeric estimate of “local” survival for Fox Sparrows of 0.352. Their survival study used a wildland study site (Coyote Hills, California) using only mist nets for capture and recapture. The southern Vancouver Island project was focused on connectivity and needed to achieve as high a level of re-capture of target birds as possible. It used cultivated backyards, with a variety of recapture methods and baiting the sites with bird food. The different site characteristics of the Coyote Hills study and this study, and the different observational intensity and recapture techniques, prevents direct comparison of survival rates in the two studies.

The intensity of the observation effort provides an opportunity to calculate true survival (*i.e.* the bird is still alive). The extreme effort made in this project to detect birds at geolocator sites means it is very unlikely that any banded birds at those sites remained undetected. All sites at which geolocators had been installed were observed daily for most of the winter season. As geolocators had been installed on birds at 16 of 21 sites, the majority of sites were intensely covered. Very high site fidelity was confirmed, based on the number of birds returning to the precise location of original capture. Likewise, the intense search effort minimizes the likelihood that returning birds were somehow ‘missed’ due to local movements or detectability. Therefore, an estimate of “true” survival, rather than “local”, can be calculated. To determine true survival, returns were corrected to take into account changes to site condition and inconsistent monitoring at three of the 21 banding sites. Birds from these locations were not included in corrected survival calculations. After deducting birds from these three sites a total of 83 banded birds remain. Of these birds, 19 adults and 14 young (ages at time of banding) returned. The adjusted return (survival) rates (Table 2) are: adult birds 51%, juvenile birds 30% and overall for all age classes, 40%.

For young birds the adjusted return rate is low, at only 30% (Table 2). It is important to note that the level of ef-

Table 2. Calculation of true survival rates of adult Fox Sparrows on southern Vancouver Island, after adjustment for three sites with low observational effort and high mortality. Estimates for all birds and for geolocator birds only are presented.

	Banded 2012–2013			Recaptured/Observed 2013–2014		
	Adult	Young	Total	Adult	Young	Total
All birds						
Total	53	62	115	20	15	35
Eliminated	16	16	32	1	1	2
Corrected	37	46	83	19 (51%)	14 (30%)	33 (40%)
Geolocator Birds						
Total Geolocators	30		30			15
Eliminated	9		9			1
Corrected	21		21			14 (67%)

fort for recapturing or re-sighting young birds was considerably lower than the effort to find adult birds and especially those with geolocators. Also, Sandercock and Jaramillo (2002) report that: “site fidelity of migratory sparrows appears to be flexible among immature birds but becomes fixed with increasing age”. It is to be expected that return rates and survival of young birds are lower than for the general population. The calculated return rate for young birds should therefore be considered a low estimate of survival.

These numbers are probably still an under-estimate of true survival. The level of observation was most intense only for geolocator carrying birds. The estimate of true survival should therefore be calculated based on only this sub-set of the adult Fox Sparrows. Of the 30 geolocator carrying birds, nine are excluded as they were banded and geolocators installed at sites where conditions changed. Fourteen of the remaining 21 geolocator carrying birds returned to their original banding location the following winter (Table 2). A corrected estimate of true adult survival of 67% is concluded for geolocator carrying (adult) birds.

Survival in following years

For an adult bird, at time of banding in 2012–13, the winter of 2017–18 would have been its eighth (at least) round trip south from the breeding areas (Table 1). If a corrected return rate of 51% (Table 2) for adult birds is accepted, the number of birds surviving from the original 37 (adjusted) banded adult birds would be 19 the following year. This is one fewer than the adjusted number of surviving adult birds observed in the winter of 2013–14. In subsequent years the predicted numbers would be ten, five, three, one and one. These are close to the actual numbers observed (Table 1).

There are three other factors to be considered in estimating survival. First, some of the adult birds banded in 2012–13 would most likely already have been more than two years old. Age beyond “after hatch year” cannot be determined for Fox Sparrows, so we assumed all adult birds

were in their second year at time of banding. Second, all banded birds except one, in this study, were present at feeders. This may have improved condition and survival. Third is the question of whether the presence of a geolocator affects the survival of the bird. Although the first attempt at installing dummy geolocators became a learning session and produced no useful data, the second showed that half of all birds with “dummies” returned the following winter, even though they were “young” birds at time of banding. This is approximately the same ratio as for geolocator carrying birds. Although a very small sample, this result tends to confirm the assumption that the electrical fields and magnetism created by a geolocator causes no difference to survival of Fox Sparrows. It is therefore concluded that once the bird has survived its first year of life, it has at least a 50% chance of surviving one more year, and perhaps a 65% or even slightly higher chance of surviving one more year.

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