Appendices A, B, and C, a supplement to:

Knutson, M. G., L. A. Powell, M. A. Friberg, G. J. Niemi, and R. K. Hines. 2006. An assessment of bird habitat quality using population growth rates. Condor 108:301-314. http://www.bioone.org/

APPENDIX A. Habitat-specific parameter estimates (SE or SD) and nest sample size (*n*) for landbird species derived primarily from field data from the Driftless Area (1992-1998). These parameters were used to estimate seasonal productivity and annual population growth rates. Nests were distributed among upland and floodplain sites; floodplain sites were represented by maple, mast, and young forest stand types. Analysis was conducted for species with ≥5 nests or ≥100 observation days in a specific habitat.

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction[a,b]
Ruby-throated Hummingbird	Upland	39	0.06	0.983 (0.004)	1.88 (0.36)	0	–[c]	–[c]	–[c]	0[c]
Red-headed Woodpecker	All sites	9	0.06	0.996 (0.004)	4.48 (0.68)	0	–[c]	–[c]	–[c]	0[c]
	Floodplain, all	8		0.996 (0.004)		0	–[c]	–[c]	–[c]	
	Floodplain, mast	6		0.995 (0.005)		0	–[c]	–[c]	–[c]	
Red-bellied Woodpecker	All sites	29	0.35	0.995 (0.003)	4.31 (0.76)	0	–[c]	–[c]	–[c]	0[c]
	Upland	22		0.996 (0.003)		0	–[c]	–[c]	–[c]	
	Floodplain, all	7		0.991 (0.009)		0	–[c]	–[c]	–[c]	
Hairy Woodpecker	All sites	35	0.23	0.998 (0.002)	4 (–)	0	–[c]	–[c]	–[c]	0[c]
	Upland	16		1.000 (0.000)		0	–[c]	–[c]	–[c]	
	Floodplain, all	19		0.995 (0.005)		0	–[c]	–[c]	–[c]	
	Floodplain, maple	11		0.990 (0.010)		0	–[c]	–[c]	–[c]	
Eastern Wood-Pewee	All sites	134	1.11	0.975 (0.003)	3.00 (0.48)	0.023 (0.024)	0.0 (0/3)	0.667 (2/3)	0.333 (1/3)	0.9[d]
	Upland	91		0.972 (0.004)		0.033 (0.029)	0.0 (0/3)	0.667 (2/3)	0.333 (1/3)	
	Floodplain,	43		0.980 (0.005)		0	–[c]	–[c]	–[c]	

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction [a,b]
	all									
	Floodplain, maple	31		0.979 (0.006)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	6		0.983 (0.012)		0	– [c]	– [c]	– [c]	
	Floodplain, young	6		0.984 (0.011)		0	– [c]	– [c]	– [c]	
Acadian Flycatcher	Upland	15	0.08	0.984 (0.008)	2.9 (0.02)	0.13 (0.054)	0.0 (0/2)	0.0 (0/2)	1.0 (2/2)	0.03[e]
Great Crested Flycatcher	All sites	26		0.991 (0.004)	4.7 (0.15)[q]	0	– [c]	– [c]	– [c]	0[c]
	Floodplain, all	25		0.990 (0.004)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	11		0.984 (0.009)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	10		0.995 (0.005)		0	– [c]	– [c]	– [c]	
	Floodplain, young	4		0.992 (0.008)		0	– [c]	– [c]	– [c]	
Warbling Vireo	Floodplain, all	41	0.59	0.966 (0.007)	3.8 (0.71)	0.026 (0.025)	1.00 (1/1)	0.0 (0/1)	0.0 (0/1)	1.8[f]
	Floodplain, maple	15		0.982 (0.008)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	8		0.961 (0.016)		0	– [c]	– [c]	– [c]	
	Floodplain, young	18		0.950 (0.015)		0.056 (0.037)	1.00 (1/1)	0.0 (0/1)	0.0 (0/1)	
Red-eyed Vireo	Upland	43	0.84	0.960 (0.008)	2.6 (1.1)	0.31 (0.074)	0.077 (1/13)	0.231 (3/13)	0.691 (9/13)	0.00[g]
Blue Jay	All sites	29	0.52	0.972 (0.007)	4.17 (0.76)	0	– [c]	– [c]	– [c]	0[c]
	Upland	17		0.965 (0.012)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	11		0.980 (0.009)		0	– [c]	– [c]	– [c]	
Tree Swallow	Floodplain, all	22	0.52	0.992 (0.004)	4.71 (0.34)	0	– [c]	– [c]	– [c]	0[c]
	Floodplain, maple	8		0.995 (0.005)		0	– [c]	– [c]	– [c]	

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction [a,b]
	Floodplain, mast	8		0.977 (0.006)		0	– [c]	– [c]	– [c]	
	Floodplain, young	6		0.987 (0.013)		0	– [c]	– [c]	– [c]	
Black-capped Chickadee	All sites	51	0.42	0.987 (0.004)	4.76 (1.08)	0	– [c]	– [c]	– [c]	0[c]
	Upland	25		0.980 (0.007)		0	– [c]	– [c]	– [c]	
	Floodplain, all	26		0.994 (0.004)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	16		0.991 (0.006)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	7		1.000 (0.000)		0	– [c]	– [c]	– [c]	
House Wren	All sites	55	0.82	0.984 (0.004)	6.00 (0.80)	0	– [c]	– [c]	– [c]	0[c]
	Upland	6		0.983 (0.012)		0	– [c]	– [c]	– [c]	
	Floodplain, all	49		0.984 (0.004)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	36		0.984 (0.005)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	10		0.988 (0.007)		0	– [c]	– [c]	– [c]	
Blue-gray Gnatcatcher	All sites	113	0.59	0.966 (0.004)	2.7 (–)	0.035 (0.017)	0.25 (1/4)	0.25 (1/4)	0.50 (1/4)	0.9[d]
	Upland	72		0.966 (0.005)		0.014 (0.014)	0	0	1.0(1/1)	
	Floodplain all	41		0.965 (0.007)		0.073 (0.041)	0.33 (1/3)	0.33 (1/3)	0.33 (1/3)	
	Floodplain, maple	13		0.962 (0.013)		0	0	0	0	
	Floodplain, mast	9		0.945 (0.020)		0	0	0	0	
	Floodplain, young	19		0.973 (0.008)		0.158 (0.084)	0.33 (1/3)	0.33 (1/3)	0.33 (1/3)	
Wood Thrush	Upland	40	0.13	0.966 (0.008)	2.78 (1.31)	0.525 (0.079)	0.00 (0/21)	0.00 (0/21)	1.00 (21/21)	0.90[g]
American Robin	All sites	167	1.04	0.970 (0.003)	2.5 (0.15)	0	– [c]	– [c]	– [c]	0[c]
	Upland	46		0.965 (0.007)		0	– [c]	– [c]	– [c]	

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction [a,b]
	Floodplain, all	121		0.972 (0.004)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	75		0.975 (0.005)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	23		0.966 (0.010)		0	– [c]	– [c]	– [c]	
	Floodplain, young	23		0.966 (0.010)		0	– [c]	– [c]	– [c]	
Gray Catbird	All sites	89	0.30	0.964 (0.005)	3.4 (0.79)	0.012 (0.01)	0.0 (0/1)	0.0 (0/1)	1.0 (1/1)	0.12[h]
	Upland	40		0.964 (0.008)		0.025 (0.03)	0.0 (0/1)	0.0 (0/1)	1.0 (1/1)	
	Floodplain, all	49		0.964 (0.007)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	28		0.955 (0.011)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	11		0.963 (0.015)		0	– [c]	– [c]	– [c]	
	Floodplain, young	10		0.979 (0.010)		0	– [c]	– [c]	– [c]	
Brown Thrasher	Floodplain, all sites	8	0.04	0.978 (0.013)	3.6 (–)	0	– [c]	– [c]	– [c]	0.64[i]
Yellow Warbler	All sites	55	0.28	0.952 (0.008)	4.45 (0.02)	0.145 (0.048)	0.125 (1/8)	0.125 (1/8)	0.750 (6/8)	1.1[j]
	Floodplain, all	52		0.951 (0.008)		0.154 (0.050)	0.125 (1/8)	0.125 (1/8)	0.750 (6/8)	
	Floodplain, maple	23		0.956 (0.012)		0.217 (0.086)	0.000 (0/5)	0.200 (1/5)	0.800 (4/5)	
	Floodplain, young	28		0.949 (0.012)		0.107 (0.058)	0.000 (0/3)	0.333 (1/3)	0.667 (2/3)	
American Redstart	All sites	267	1.76	0.945 (0.004)	2.89 (1.16)	0.169 (0.023)	0.067 (3/45)	0.311 (14/45)	0.622 (28/45)	0.9[d]
	Upland	62		0.953 (0.008)		0.177 (0.049)	0.091 (1/11)	0.455 (5/11)	0.455 (5/11)	
	Floodplain, all	205		0.943 (0.005)		0.166 (0.026)	0.059 (2/34)	0.265 (9/34)	0.676 (23/34)	
	Floodplain, maple	175		0.945 (0.005)		0.166 (0.028)	0.035 (1/29)	0.241 (7/29)	0.724 (21/29)	
	Floodplain, mast	16		0.932 (0.018)		0.125 (0.083)	0.000 (0/2)	0.500 (1/2)	0.500 (1/2)	

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction [a,b]
	Floodplain, young	14		0.928 (0.021)		0.214 (0.110)	0.333 (1/3)	0.333 (1/3)	0.333 (1/3	
Prothonotary Warbler	Floodplain, all	159	0.48	0.969 (0.004)	3.95 (1.67)	0.189 (0.031)	0.100 (3/30)	0.133 (4/30)	0.767 (23/30)	0.89[k]
	Floodplain, maple	85		0.969 (0.005)		0.106 (0.033)	0.000 (0/9)	0.111 (1/9)	0.889 (8/9)	
	Floodplain, mast	33		0.977 (0.007)		0.242 (0.075)	0.000 (0/8)	0.250 (2/8)	0.750 (6/8)	
	Floodplain, young	41		0.959 (0.009)		0.317 (0.073)	0.231 (3/13)	0.077 (1/13)	0.692 (9/13)	
Ovenbird	Upland	25	0.61	0.958 (0.012)	2.90 (–)	0.375 (0.08)	0.11 (1/9)	0.0 (0/9)	0.89 (8/9)	0.52[l]
Scarlet Tanager	Upland	71	0.25	0.969 (0.005)	3.80 (0.05)	0.07 (0.04)	0.20 (1/5)	0.00 (0/5)	0.80 (4/5)	1.2[m]
Northern Cardinal	All sites	41	0.37	0.951 (0.010)	1.93 (0.80) [r]	0.02 (0.02)	0.0 (0/1)	0.0 (0/1)	1.0 (1/1)	0.3[n]
	Upland	19		0.943 (0.016)		0.05 (0.04)	0.0 (0/1)	0.0 (0/1)	1.0 (1/1)	
	Floodplain, all	22		0.956 (0.012)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	11		0.963 (0.015)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	8		0.964 (0.017)		0	– [c]	– [c]	– [c]	
Rose-breasted Grosbeak	All sites	103	0.38	0.962 (0.005)	2.82 (–)	0.040 (0.02)	0.0 (0/4)	0.25 (1/4)	0.75 (3/4)	1.8[o]
	Upland	75		0.962 (0.006)		0.056 (0.03)	0.0 (0/4)	0.25 (1/4)	0.75 (3/4)	
	Floodplain, all	28		0.962 (0.009)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	12		0.955 (0.016)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	11		0.972 (0.013)		0	– [c]	– [c]	– [c]	
	Floodplain, young	5		0.955 (0.025)		0	– [c]	– [c]	– [c]	
Indigo Bunting	Upland	30	0.23	0.950 (0.011)	3.41 (0.58)	0.53 (0.08)	0.19 (3/16)	0.06 (1/16)	0.75 (12/16)	1.06[p]
Baltimore Oriole	All sites	39	0.54	0.989 (0.005)	4.50 (1.09)	0	– [c]	– [c]	– [c]	0[c]

Species	Habitat	Nests (*n*)	Rel. abund. (birds ha $^{-10}$)	Daily nest survival (SE)	Fledged clutch size (SD) (fledglings)	% Parasitized	% Abandoned[a]	% Raised cowbird only[a]	% No effect[a]	Nestling reduction [a,b]
	Floodplain, all	39		0.989 (0.005)		0	– [c]	– [c]	– [c]	
	Floodplain, maple	13		0.979 (0.012)		0	– [c]	– [c]	– [c]	
	Floodplain, mast	18		0.993 (0.005)		0	– [c]	– [c]	– [c]	
	Floodplain, young	7		0.991 (0.009)		0	– [c]	– [c]	– [c]	

[a]Assuming parasitized nest.
[b]Number of nestlings reduced, but not depleted by parasite.
[c]No parasitized nests in sample.
[d]No data available on nest depletion; assumed 0.90 based on Donovan et al. (1995).
[e]Whitehead and Taylor (2002).
[f]Gardali and Ballard (2000).
[g]Lowther et al. (1999).
[h]Cimprich and Moore (1995).
[i]Cavitt and Hass (2000).
[j]Donovan et al. (1995).
[k]Petit (1999) (-22% fledge success).
[l]Van Horn and Donovan (1994).
[m]Mowbray (1999).
[n]Halkin and Linville (1999).
[o]Friesen et al. (1999).
[p]Payne (1992).
[q]Mid-values from White and Seginak (2000).
[r]Eckerle and Breitwisch (1997).

APPENDIX B. Parameter estimates from the literature used to estimate seasonal productivity and annual population growth rates for landbird species from the Driftless Area (1992-1998). Sources were the Birds of North America species accounts (Poole and Gill 1992-2004) (Appendix C), unless otherwise indicated.

Species	Adult survival, daily (SE)	Juvenile survival, daily (SE)	Breeding season length (days)	Nest building interval (days)	Nesting period (days)	Fledgling care interval (days)
Ruby-throated Hummingbird	0.9976 [a]	0.9956 [a,b]	70	8	37	6
Red-headed Woodpecker	0.9987 (0.001) [c]	0.9968 (0.002) [b]	60	14	39	10
Red-bellied Woodpecker	0.9987 (0.001) [d]	0.9968 (0.002) [b,d]	47	14	37	14
Hairy Woodpecker	0.9981 (0.0015) [e]	0.9962 (0.003) [b]	60	20	40	28
Eastern Wood-Pewee	0.9975 (0.0013) [e]	0.9956 (0.0025) [b]	52	5 [f]	30	14 [f]
Acadian Flycatcher	0.9987 (0.0006) [e]	0.9968 (0.0013) [b]	41	8	31	14
Great Crested Flycatcher	0.9978 (0.001) [e]	0.9959 (0.003) [b]	45	3	28	21
Warbling Vireo	0.9984 (0.0002) [e]	0.9965 (0.0004) [b]	53	6	28	14 [f]
Red-eyed Vireo	0.9982 (0.0006) [e]	0.9963 (0.0013) [b]	57	5	25	14
Blue Jay	0.9983 (0.0014) [e]	0.9978 (0.0005) [g]	99	10	40	30
Tree Swallow	0.9992 (0.001) [e]	0.9957 (0.001) [h]	59	15	34	3
Black-capped Chickadee	0.9984 (0.00006) [i]	0.9978 (0.0001) [i]	76	5	28	21
House Wren	0.9976 (0.0007) [e]	0.9957 (0.0015) [b]	50	10	28	8
Blue-gray Gnatcatcher	0.9977 (0.0003) [j]	0.9958 (0.0003) [b]	60	10	26	21
Wood Thrush	0.9973 (0.006) [k]	0.9966 (0.001) [k]	66	5 [k]	24 [k]	18 [k]
American Robin	0.9987 (0.0008) [e]	0.9968 (0.0017) [b]	101	6	26	7
Gray Catbird	0.9981 (0.0003) [e]	0.9962 (0.0006) [b]	61	5	23	8
Brown Thrasher	0.9980 (0.0008) [e]	0.9961 (0.0016) [b]	73	4	24	8
Yellow Warbler	0.9983 (0.0004) [e]	0.9964 (0.0007) [b]	63	4	21	17
American Redstart	0.9989 [a]	0.9970 [a]	53	5	20	21
Prothonotary Warbler	0.9979 (0.0002)	0.9960 (0.0001) [b]	53	5	23	35
Ovenbird	0.9986 (0.0009) [e]	0.9967 (0.0018) [b]	43	5	20	25
Scarlet Tanager	0.9970 (0.0024)	0.9951 (0.0048) [b]	66	4	27	14
Northern Cardinal	0.9984 (0.0005) [e]	0.9966 (0.0010) [b]	117	5	22	15

Species	Adult survival, daily (SE)	Juvenile survival, daily (SE)	Breeding season length (days)	Nest building interval (days)	Nesting period (days)	Fledgling care interval (days)
Rose-breasted Grosbeak	0.9993 (0.001) [e]	0.9974 (0.002) [b]	76	4	23	21
Indigo Bunting	0.9974 (0.0009) [e]	0.9955 (0.0018) [b]	91	5	23	12 [l]
Baltimore Oriole	0.9968 (0.001) [e]	0.9949 (0.003) [b]	61	7	25	14

[a] SE estimates for juvenile and adult survival not available; used SE for Prothonotary Warbler survival.
[b] No juvenile survival available; assumed juvenile survival was ½ of adult survival, following Temple and Cary (1988) and Donovan et al. (1995).
[c] SE estimates for juvenile and adult survival not available; used SE for Hairy Woodpecker.
[d] No juvenile or adult survival available; used estimates from Red-headed Woodpecker.
[e] DeSante et al. (1998).
[f] No data available; used common data from other species.
[g] Hickey and Brittingham (1991).
[h] No variance available for juvenile survival; used adult variance.
[i] Loery et al. (1997).
[j] No survival data available; used estimates for Common Yellowthroat (*Geothlypis trichas*) (DeSante et al. 1998). The Common Yellowthroat is similar in size and migration distance (winter ranges are comparable) (DeGraaf and Rappole 1995). Estimates comparable with survival estimates used for population models of the California Gnatcatcher (*Polioptila c. californica*) (Akcakaya and Atwood 1997).
[k] Powell et al. (1999).
[l] Westneat (1988).

APPENDIX C. Additional model constraints used to estimate seasonal productivity and annual population growth rates for landbird species from the Driftless Area (1992-1998).

Species	Model constraint
Ruby-throated Hummingbird	≤ 2 successful broods (Robinson et al. 1996)
Red-headed Woodpecker	≤ 2 successful broods (Smith et al. 2000)
Red-bellied Woodpecker	≤ 2 successful broods (Shackelford et al. 2000)
Hairy Woodpecker	≤ 1 successful brood (Jackson et al. 2002)
Eastern Wood-Pewee	≤ 2 successful broods (McCarty 1996)
Acadian Flycatcher	≤ 2 successful broods (Whitehead and Taylor 2002)
Great Crested Flycatcher	1 nesting attempt if successful, 2 attempts if first unsuccessful (Lanyon 1997)
Warbling Vireo	≤ 2 successful nests (Gardali and Ballard 2000)
Red-eyed Vireo	≤ 2 successful broods (Cimprich et al. 2000)
Blue Jay	≤ 2 successful broods (Tarvin and Woolfenden 1999)
Tree Swallow	1 nesting attempt if successful, 2 attempts if first unsuccessful (Robertson et al. 1992)
Black-capped Chickadee	≤ 1 successful brood (Smith 1993)
House Wren	≤ 2 successful broods (Johnson 1998)
Blue-gray Gnatcatcher	≤ 2 successful broods (Ellison 1992)
Wood Thrush	No additional constraints (Roth et al. 1996)
American Robin	≤ 3 successful broods (Sallabanks and James 1999)
Gray Catbird	≤ 2 successful broods in northern U.S. (Cimprich and Moore 1995)
Brown Thrasher	≤ 4 nesting attempts; no more than 1 successful nest (Cavitt and Haas 2000)
Yellow Warbler	≤ 1 successful brood (Lowther et al. 1999)
American Redstart	≤ 1 successful nest or 4 attempts (Sherry and Holmes 1997)
Prothonotary Warbler	Probability of laying 2 clutches (30%), probability of laying 3 clutches (5%), and ≤ 2 successful broods or 3 attempts (Petit 1999)
Ovenbird	≤ 1 successful brood; ≤ 2 nesting attempts (Van Horn and Donovan 1994)
Scarlet Tanager	≤ 1 successful brood; no more than 2 nesting attempts (Mowbray 1999)
Northern Cardinal	≤ 4 successful broods (Halkin and Linville 1999)
Rose-breasted Grosbeak	1 nesting attempt if successful, 2 attempts if first unsuccessful (Wyatt and Francis 2002)
Indigo Bunting	≤ 7 nesting attempts; ≤ 3 successful nests (Payne 1992)
Baltimore Oriole	≤ 1 successful brood (Rising and Flood 1998)

LITERATURE CITED, APPENDICES A-C

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