The Condor 98:27–33

WETLAND SELECTION BY AMERICAN GREEN-WINGED TEAL BREEDING IN BRITISH COLUMBIA[1]

GIL A. PAQUETTE[2] AND C. DAVISON ANKNEY
Department of Zoology, University of Western Ontario,
London, Ontario, N6A 5B7, Canada

Abstract. We examined wetland selection by breeding Green-winged Teal (*Anas crecca carolinensis*) in terms of wetland fertility near Riske Creek, British Columbia, Canada. We conducted 12 breeding-pair surveys to classify use of 96 wetlands. We evaluated wetland fertility by analyzing water chemistry (pH, conductivity, alkalinity [$CaCO_3$], total phosphorus, chlorophyll *a*) and physical characteristics (percent emergent cover, area of wetland 0–1 m depth, wetland size). There was significant variation in chemical and physical variables between unused ($n = 47$) and used ($n = 49$) wetlands (MANOVA, Wilks' lambda = 0.8054, $P = 0.0126$). On average, water chemistry measurements, total area (m^2) and area 0–1 m (m^2) depth were greater in used wetlands, whereas percent cover was lower. Also, there was significant variation in chemical and physical variables between unused ($n = 47$), infrequently used ($n = 26$), and frequently used ($n = 23$) wetlands (MANOVA, Wilks' lambda = 0.6951, $P = 0.0085$). On average, water chemistry measurements, total area (m^2) and area 0–1 m (m^2) were positively correlated with wetland use, whereas percent cover was negatively correlated. We conclude that wetland fertility is an important factor influencing landscape and geographic distribution of breeding Green-winged Teal.

Key words: Anas crecca carolinensis; *Green-winged Teal; wetland characteristics; fertility; water chemistry.*

INTRODUCTION

Green-winged Teal (*Anas crecca carolinensis*) have been studied extensively in winter (Tamisier 1976; Bennet and Bolen 1978; Quinlan and Baldassarre 1984; Baldassarre and Bolen 1984, 1986; Baldassarre et al. 1986; Rave and Baldassarre 1989, 1991). Little research, however, has been done during the reproductive period, probably because Green-winged Teal nest in low densities throughout most of their range (Bellrose 1980). In particular, little is known about habitat selection by Green-winged Teal. Ecologists are often interested in what factors determine habitat selection because the selection of optimal habitat is important for maximizing evolutionary fitness (Partridge 1978).

Wetland selection by breeding ducks has been studied frequently (Dwyer et al. 1979, Ringleman et al. 1982, Mulhern et al. 1985, Diefenbach and Owen 1989) and such research indicates that wetland fertility is an important component of wetland selection (Murphy et al. 1984, Parker et al. 1992, Merendino et al. 1993, Merendino and Ankney 1994). Indeed, because energy and other nutrient requirements of egg-laying waterfowl are large relative to those of other bird species (Lack 1968), reproductive output of temperate nesting ducks may be particularly sensitive to wetland fertility (Krapu and Reinecke 1992).

Females of most waterfowl species store nutrient reserves to mitigate their high nutrient demands for reproduction (Alisauskas and Ankney 1992). The amount of nutrients that can be stored for reproduction is positively correlated with body size. Thus, some larger bodied ducks transport reserves from migration or wintering areas.

Green-winged Teal are the smallest North American species of *Anas*, weighing, on average, 300 grams (Alisauskas and Ankney 1992). They cannot deposit large absolute amounts of nutrient reserves while occupying wintering or migration habitats. Furthermore, Green-winged Teal have high nutrient demands for reproduction and have relatively little ability to mitigate them by use of reserves. For example, each egg laid by a Mallard (*Anas platyrhynchos*) represents about 168 percent of daily basal metabolic rate (BMR), whereas in Green-winged Teal it represents 202 percent of daily BMR (see Alisauskas and Ankney 1992) [BMR = 73.5 Body $Mass^{0.73}$ (Aschoff and Pohl 1970)]. Also, based on average clutch size and average egg mass, a

---

[1] Received 19 May 1995. Accepted 28 September 1995.

[2] Corresponding author's present address: Institute for Wetland and Waterfowl Research, P.O. Box 1160, Stonewall, MB R0C 2Z0, Canada.

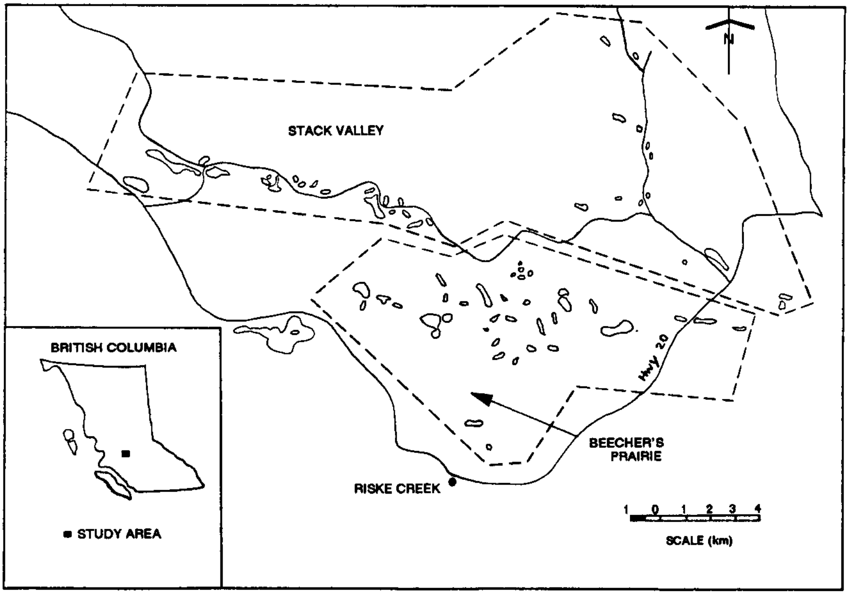

FIGURE 1. Location of study area. Dashed lines indicate boundaries for Stack Valley and Beecher's Prairie. Only larger wetlands shown, i.e., wetlands greater than 0.5 hectares.

Mallard's clutch represents about 58 percent of body mass, but a Green-winged Teal's clutch represents about 78 percent of body mass (Lack 1968). Thus, wetland selection by Green-winged Teal should be particularly sensitive to food availability and thus, to variation in wetland fertility.

Our primary objective was to determine if fertility differed between wetlands used and not used by breeding Green-winged Teal. Secondarily, we also compared fertility of wetlands used infrequently, frequently, and those not used by breeding Green-winged Teal.

STUDY AREA AND METHODS

The Riske Creek area (51°58′N, 122°32′W) is in the aspen parkland on the Fraser Plateau of South Central British Columbia, about 40 km west of Williams Lake (Fig. 1). The area has at least 96 wetlands (between 1 and 50 ha) distributed over 150 km^2 and is the center of one of the most important wetland complexes for breeding waterfowl in British Columbia (McKelvey and Munro 1983). We chose this area because Canadian Wildlife Service surveys (1980–1986) showed a relatively high density of breeding Green-winged Teal [$\bar{x}$ = 66 ± 3 (SE) indicated breeding pairs/year on the study area] (Savard 1991).

Wetlands on the study area differed greatly in physical and chemical characteristics and are described in detail by Boyd and Savard (1987). All wetlands are devoid of fish and support high densities of invertebrates (Reynolds 1979, Boyd and Smith 1989).

Great bulrush (*Scirpus lacustris*) and cattail (*Typha latifolia*) occurs in shallow depressions and around the perimeter of open water in some deep wetlands. Water sedge (*Carex aquatilis*), beaked sedge (*C. rostrata*), slender sedge (*C. lasiocarpa*), alkali saltgrass (*Distichlis stricta*), Nuttall's alkaligrass (*Puccinellia nuttalliana*), and foxtail barley (*Hordeuam jubatum*) also occur in varying degrees along the perimeter of more shallow wetlands. Because of high pH, alkalinity, and conductivity, some wetlands are devoid of emergent vegetation.

Upland vegetation is predominantly coniferous forests of Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and aspen (*Populus tremuloides*). Douglas-fir is considered the climax tree species but extensive lodgepole pine and aspen forests have been maintained by wildfires and controlled burns prescribed by the British Columbia Ministry of Forests and local cattle ranchers (Steen and Roberts 1988). The southern part of the study area, known as Beecher's Prairie, is predominantly a mix of grassland, lodgepole pine, and aspen, but the northern part, known as Stack Valley, is predominantly Douglas-fir. Most wetlands are at least partially surrounded by forest.

BREEDING PAIR LOCATIONS

Twelve surveys of "indicated breeding pairs" were conducted from 13 April to 20 June 1993. We defined an "indicated breeding pair" as: 1) a lone female, 2) a lone male, 3) a male/female pair, and 4) a group of two males (see Hammond 1969). Survey data were used to delineate wetlands as used and unused by breeding Green-winged Teal. Wetlands used by Green-winged Teal were further categorized as infrequently used and frequently used based on frequency of occurrence by indicated pairs (see Results).

HABITAT EVALUATION

WATER CHEMISTRY

Phosphorus. Water samples (one per wetland) were collected in 50-ml, FISHER brand disposable sterile centrifuge tubes immediately after a wetland became ice-free (13–29 April); levels of total phosphorus available for biological processes are reportedly highest at this time (LaBaugh 1989). Bottom contour maps (Boyd and Savard 1987) were used to identify the deepest part of the wetland from which samples were taken (C. G. Trick, pers. comm.). Sample tubes were inverted and lowered to arms-length depth, righted, and allowed to fill (Brooksbank et al. 1989). When wetlands were shallow enough to allow sampling by wading, caution was used not to disturb the substrate and to sample quickly before mixing could occur. All other samples were taken from a canoe.

Sample tubes were placed on ice until samples were filtered through Whatman GF/C glass microfibre filters. Forty milliliters of the samples were placed in clean, 50-ml FISHER brand disposable sterile centrifuge tubes and immediately frozen. Analysis of total phosphorus was done using a phosphorus test kit (HACH; PhosVer 3 Phosphate Reagent Powder Pillows, 0.01 mg/l detection limit).

Conductivity and pH. Portable meters were used to determine conductivity (Hanna Instruments; HI 8033) and pH (Canlab Model 607) from 3–10 June. For both measurements, the probe was placed 30 cm below the water surface in waist-deep water. Three readings were taken from each wetland and the average recorded.

Alkalinity. Water samples (one per wetland) were collected from 3–10 June in 250-ml plastic bottles in waist-deep water. Bottles were inverted and lowered to arms-length depth, righted, and allowed to fill (Brooksbank et al. 1989). Alkalinity was determined, in the field, using a Total Alkalinity Test Kit (Orion Res. Inc.).

Chlorophyll a. Water samples (one per wetland) were collected in 250-ml glass bottles in waist-deep water from 29 June–3 July. Bottles were inverted and lowered to arms-length depth, righted, and allowed to fill (Brooksbank et al. 1989). Each sample was filtered through a Whatman GF/C glass microfibre filter using a Nalgene pump. The pressure differential during filtration did not exceed 0.3 atm, minimizing damage to cells. Two drops of magnesium carbonate slurry were then placed on the filter to prevent degradation of pigments. Filters were folded in half, wrapped in aluminum foil, and frozen (Strickland and Parsons 1968). In the lab, procedures outlined by Strickland and Parsons (1968) were used to determine concentration of chlorophyll *a* pigment.

PHYSICAL CHARACTERISTICS

Percent emergent cover was visually estimated to the nearest 5 percent at each wetland. Total area of each wetland and area of each wetland 0–1 m in depth were obtained from Boyd and Savard (1987).

STATISTICAL ANALYSES

We used multivariate analysis of variance (MANOVA) (SAS Institute 1985) to determine if there were overall differences in the chemical/physical variables between used and unused wetlands. Canonical Discriminant Analysis (CDA) (SAS Institute 1985) was used to determine how wetland groups differed with respect to various wetland variables. Group differences were illustrated by constructing a histogram of discriminance scores for 2-sample tests and 95 percent confidence ellipses for 3-sample tests. For the 3-sample tests, we used variances, covariances and means generated from CDA to construct confidence ellipses around group means on the two canonical axes. Variables important in defining axes were determined from standardized canonical coefficients. Finally, we used one-way analysis of variance (ANOVA) (SAS Institute 1985) to determine how wetland groups differed with respect to univariate habitat variables. Be-

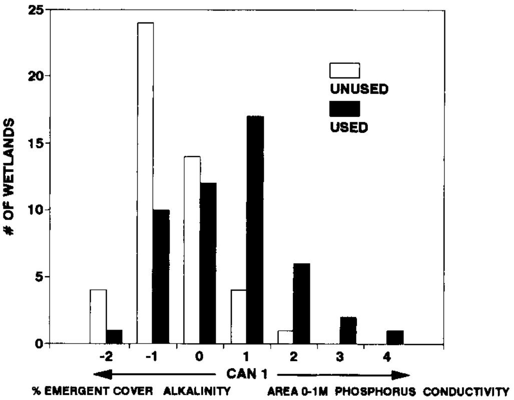

FIGURE 2. Histogram of canonical analysis of discriminance scores on the first and only canonical axis for wetlands used and unused by breeding Green-winged Teal pairs near Riske Creek, British Columbia. Variables most important in separating the wetland groups are shown (see standardized canonical coefficients; Table 1).

TABLE 1. Standardized canonical coefficients of the first and only axis from a canonical discriminant analysis indicating the importance of each variable to the separation of used and unused wetlands.[a]

Variable	Standardized canonical coefficients
Water chemistry	
pH	−0.2430
Conductivity	0.7192
Alkalinity	−0.5580
Total phosphorus	0.5609
Chlorophyll a	0.3533
Physical	
% emergent cover	−0.7225
Total area	−0.4241
Area 0–1m depth	0.5324
P-value	0.0126

[a] Variables important in defining axes are underlined. Water chemistry variables, except pH and conductivity (μmhos/cm) measured in mg/liter.

fore analysis, log(x + 1) transformations were used to correct for non-normality. Subsequently, we used normal probability plots to test for normality. Thus, except for pH, all statistical analyses were done on log(x + 1) transformed data to correct for non-normality.

RESULTS

There was significant variation in chemical and physical variables between used and unused wetlands (MANOVA, Wilks' lambda = 0.8054, *P* = 0.0126). Conductivity, alkalinity, total phosphorus, percent cover, total area (m^2) and area 0–1 m depth (m^2) were important in separating wetland groups; conductivity and percent cover contributed most to the separation (Table 1, Fig. 2). On average, water chemistry measurements, total area (m^2) and area 0–1 m (m^2) depth were greater in used wetlands, whereas percent cover was lower (Table 2).

Among used wetlands, frequency of use by Green-winged Teal was strongly bimodal (Fig. 3). Thus, we delineated those wetlands that had indicated pairs present on ≤ 4 of the 12 surveys

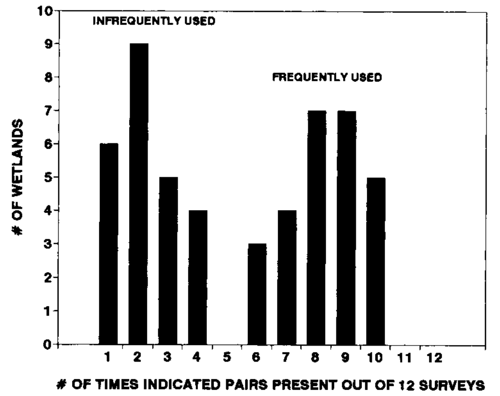

FIGURE 3. Frequency of wetland use by indicated breeding pairs of Green-winged Teal. Indicated breeding pair defined as: 1) a lone female, 2) a lone male, 3) a male/female pair, and 4) a group of two males.

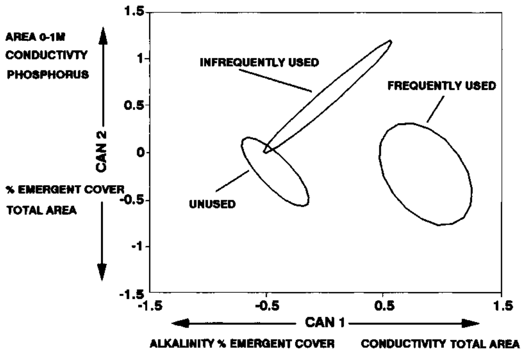

FIGURE 4. Ninety-five percent confidence ellipses on the two and only canonical axes for wetlands unused, infrequently used, or frequently used by breeding Green-winged Teal pairs near Riske Creek, British Columbia. Variables most important in separating wetland groups are shown (see standardized canonical coefficients; Table 3).

TABLE 2. Averages of chemical and physical variables for used and unused wetlands by breeding Green-winged Teal pairs near Riske Creek, British Columbia.

Variable[a]	Used (n = 49)		P	Unused (n = 47)	
	$\bar{x}$	SE		$\bar{x}$	SE
Water chemistry					
pH	8.50	0.12	0.253	8.29	0.12
Conductivity	3,453.64	637.13	0.068	1,530.52	247.73
Alkalinity	1,834.92	410.86	0.268	1,019.63	159.52
Total phosphorus	1.48	0.39	0.003	0.54	0.11
Chlorophyll a	1.00	0.22	0.050	0.46	0.06
Physical					
% emergent cover	14.20	3.09	0.010	19.09	2.74
Total area (ha)	6.44	1.32	0.050	2.99	0.45
Area 0–1 m depth (ha)	1.90	3.56	0.098	1.24	0.21

[a] Water chemistry variables, except pH and conductivity (μmhos/cm) measured in mg/liter.

as infrequently used (n = 26) and those with indicated pairs present on ≥6 of the 12 surveys as frequently used (n = 23). There was significant variation in chemical and physical variables between unused, infrequently used, and frequently used wetlands (MANOVA, Wilks' lambda = 0.6951, P = 0.0085). The two canonical axes from CDA described 67.3 percent (P = 0.0085) and 32.7 percent (P = 0.1365) of the among group variation, respectively (Table 3). Standardized canonical coefficients indicated that conductivity, alkalinity, total area (m^2), and percent cover were important in separating wetland groups; conductivity and total area (m^2) contributed most to the separation (Fig. 4). On average, water chemistry measurements, total area (m^2) and area 0–1 m (m^2) depth were significantly higher in frequently used wetlands (Table 4), whereas percent cover was lowest in frequently used wetlands.

DISCUSSION

Our analysis of used and unused wetlands showed that wetlands used by Green-winged Teal were more fertile than a sample of those not used. Phosphorus concentration was significantly greater in used wetlands, which is especially important because the relationship of ions and inorganic nutrients in wetland systems is complex, but phosphorus is perhaps the most important index of wetland productivity because it commonly limits biological productivity in aquatic ecosystems (Wetzel 1983). Also, Chlorophyll *a* was significantly greater in used wetlands, further suggesting that fertility is an important aspect of wetland selection by Green-winged Teal.

Wetlands used by Green-winged Teal also had relatively more shallow area than did unused wetlands. Wetlands with more shallow area are generally more productive than deeper wetlands of similar chemistry (Cole 1983, Wetzel 1983). Because Green-winged Teal feed by dabbling or tipping, their use of shallow wetlands, however, may reflect a response that facilitates feeding on benthic food resources or those food items found in shallow water, and not overall wetland productivity. Regardless, patterns of habitat use and morphology indicate that each waterfowl species has general limits to potential food resources

TABLE 3. Standardized canonical coefficients of the two and only axes from a canonical discriminant analysis indicating the importance of each variable to the separation of used and unused wetlands.

Variable[b]	Standardized canonical coefficients[a]	
	CAN1	CAN2
Water chemistry		
pH	−0.1862	−0.2016
Conductiivty	$\underline{0.5983}$	$\underline{0.4018}$
Alkalinity	$-\underline{0.5185}$	−0.1281
Total phosphorus	0.3309	$\underline{0.5458}$
Chlorophyll a	0.3550	0.1133
Physical		
% emergent cover	$-\underline{0.4860}$	$-\underline{0.5995}$
Total area	$\underline{0.5500}$	$-\underline{1.9177}$
Area <1 m depth	−0.0134	$\underline{1.2900}$
Eigenvalues	0.2715	0.1315
% variation explained	67.3	32.7
P-value	0.0085	0.1365

[a] Variables important in defining axes are underlined.

[b] Water chemistry variables, except pH and conductivity (μmhos/cm) measured in mg/liter.

TABLE 4. Averages of chemical and physical variables for unused, infrequently used, and frequently used wetlands by breeding Green-Winged Teal pairs near Riske Creek, British Columbia.

Variable[a]	Unused (n = 47)		Infrequently used (n = 26)		Frequently used (n = 23)		
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	P
Water chemistry							
pH	8.29	0.12	8.33	0.11	8.67	0.13	0.206
Conductivity	1,530.52	247.73	2,073.33	334.35	5,013.92	802.89	0.050
Alkalinity	1,019.63	159.52	1,151.92	217.34	2,607.11	532.18	0.202
Total phosphorus	0.54	0.11	1.17	0.17	1.76	0.17	0.019
Chlorophyll a	0.46	0.06	0.95	0.24	1.04	0.19	0.137
Physical							
% emergent cover	19.09	2.74	18.01	3.11	9.90	2.95	0.005
Total area (ha)	2.99	0.45	3.08	0.49	10.25	1.69	0.001
Area 0–1 m depth (ha)	1.24	0.21	1.55	2.95	2.31	4.08	0.107

[a] Water chemistry variables, except pH and conductivity (µmhos/cm) measured in mg/liter.

(Krapu and Reinecke 1992). Therefore, the biomass of food resources available to Green-winged Teal are probably greater in wetlands with more shallow area.

Mean percent emergent cover was greater in unused than in used wetlands. Lower values of percent emergent cover on used wetlands possibly indicates higher nutrient content (i.e., high alkalinity, conductivity, pH, etc.). However, this difference, though statistically different, may lack biological significance because percent emergent cover was estimated relatively early in the growing season (i.e., during the wetland selection process by Green-winged Teal) when little emergent vegetation was present.

Our multivariate analysis showed that wetland use was correlated with a fertility gradient. The first canonical axis showed that frequently used wetlands were more fertile than infrequently used wetlands and unused wetlands were the least fertile. Univariate means for water chemistry variables showed a similar pattern.

Overall, data suggest that wetland selection by Green-winged Teal is one of careful selection of most fertile wetlands from among wetland groups. Furthermore, a relatively large number of Green-winged Teal migrants pass through and forego breeding in this area, suggesting that Green-winged Teal are highly specific in wetland use. This may explain why Green-winged Teal nest in low densities, but are distributed widely across North America.

We conclude that Green-winged Teal are habitat specialists and select the most fertile wetland(s) in a wetland group. We emphasize, however, that wetland fertility may not be the only factor governing wetland selection by Green-winged Teal. Animals probably respond to more than one habitat factor (Smith 1977), and all Green-winged Teal nests found on the study area (n = 12) were in forested habitat. Therefore, forested areas close to fertile wetlands may also be co-factors governing wetland selection by Green-winged Teal.

ACKNOWLEDGMENTS

We thank Thomas Artiss and Floyd for field assistance. The study was funded by the Natural Sciences and Engineering Research Council of Canada through a research grant to CDA. We thank T. Nudds for providing helpful suggestions with an earlier draft of this paper. G. Baldassarre and J-P. Savard reviewed the manuscript and provided many helpful comments.

LITERATURE CITED

Alisauskas, R. T., and C. D. Ankney. 1992. The cost of egg laying and its relationship to nutrient reserves in waterfowl, p. 31–61. *In* B.D.J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu [eds.], Ecology and management of breeding waterfowl. Univ. Minnesota Press, Minneapolis.

Aschoff, J., and H. Pohl. 1970. Rhythmic variations in energy metabolism. Fed. Proc. 29:1541–1552.

Baldassarre, G. A., and E. G. Bolen. 1984. Field-feeding ecology of waterfowl wintering on the High Plains of Texas. J. Wildl. Manage. 48:63–71.

Baldassarre, G. A., and E. G. Bolen. 1986. Body weight and aspects of pairing chronology of Green-winged Teal and Northern Pintails wintering on the southern High Plains of Texas. Southwest. Nat. 31:361–366.

Baldassare, G. A., R. J. Whyte, and E. G. Bolen. 1986. Body weight and carcass composition of non-breeding Green-winged Teal on the southern high plains of Texas. J. Wildl. Manage. 50:420–426.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA.

Bennett, J. W., and E. G. Bolen. 1978. Stress response in wintering Green-winged Teal. J. Wildl. Manage. 42:81–86.

Boyd, W. S., and J-P. L. Savard. 1987. Abiotic and biotic characteristics of wetlands at Riske Creek, British Columbia—a data report. Canadian Wildlife Service Technical Report No. 16. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Boyd, W. S., and D. W. Smith. 1989. Summary of aquatic invertebrate data collected from wetlands at Riske Creek, British Columbia, 1984 and 1985. Technical Report No. 60. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Brooksbank, P., J. Haemmerli, G. Howell, and L. Johnston. 1989. Long range transport of airborne pollutants (LRTAP) aquatic effects monitoring. Environment Canada, Inland Waters Directorate, Ottawa. Tech. Bull. 156.

Cole, G. A. 1983. Textbook of limnology. 3rd. ed. The C. V. Mosby Co. St. Louis, MO.

Diefenbach, D. R., and R. B. Owen. 1989. A model of habitat use by breeding American Black Ducks. J. Wildl. Manage. 53:383–389.

Dwyer, T. J., G. L. Krapu, and D. M. Janke. 1979. Use of prairie pothole wetlands by breeding Mallards. J. Wildl. Manage. 43:526–531.

Hammond, M. C. 1969. Notes on conducting waterfowl breeding population surveys, p. 238–258. *In* Saskatoon wetlands seminar. Can Wildl. Serv. Rep. Ser. 6.

Krapu, G. L., and K. J. Reinecke. 1992. Foraging ecology and nutrition, p. 1–29. *In* B.D.J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu [eds.], Ecology and management of breeding waterfowl. Univ. Minnesota Press, Minneapolis.

LaBaugh, J. W. 1989. Chemical characteristics of water in northern prairie wetlands, p. 56–91. *In* A. G. van der Valk [ed.], Northern prairie wetlands. Iowa State Univ. Press, Ames.

Lack, D. 1968. Ecological adaptations for breeding in birds. Methuen & Co., Ltd., London.

McKelvey, R., and W. Munro. 1983. Cooperative waterfowl management plan for British Columbia. Regional report, Can. Wildl. Serv., Pacific and Yukon Region, Delta, British Columbia and British Columbia Fish and Wildl. Branch, Victoria, British Columbia, Canada.

Merendino, M. T., C. D. Ankney, and D. G. Dennis. 1993. Increasing Mallards, decreasing American Black Ducks: more evidence for cause and effect. J. Wildl. Manage. 57:199–208.

Merendino, M. T., and C. D. Ankney. 1994. Habitat use by Mallards and American Black Ducks breeding in central Ontario. Condor. 96:411–421.

Mulhern, J. H., T. D. Nudds, and B. R. Neal. 1985. Wetland selection by Mallards and Blue-winged Teal. Wilson Bull. 97:473–485.

Murphy, S. M., B. Kessel, and L. J. Vining. 1984. Waterfowl populations and limnological characteristics of taiga ponds. J. Wildl. Manage. 48:1156–1163.

Parker, G. A., M. J. Petrie, and D. T. Sears. 1992. Waterfowl distribution relative to wetland acidity. J. Wildl. Manage. 56:268–274.

Partridge, L. 1978. Habitat selection, p. 351–376. *In* J. R. Krebs and N. B. Davies [eds.], Behavioural ecology. Sinauer Associates, Inc., Sunderland MA.

Quinlan, E. E., and G. A. Baldassarre. 1984. Activity budgets of nonbreeding Green-winged Teal on playa lakes in Texas. J. Wildl. Manage. 48:838–845.

Rave, D. P. and G. A. Baldassarre. 1989. Activity budget of Green-winged Teal wintering in coastal wetlands of Louisiana. J. Wildl. Manage. 53:753–759.

Rave, D. P., and G. A. Baldassarre. 1991. Carcass mass and composition of Green-winged Teal wintering in Louisiana and Texas. J. Wildl. Manage. 55:457–461.

Reynolds, J. D. 1979. Crustacean zooplankton of some saline lakes of central British Columbia. Syesis 12:169–173.

Ringleman, J. K., J. R. Longcore, and R. B. Owen, Jr. 1982. Breeding habitat selection and home range of radio-marked Black Ducks (Anas rubripes) in Maine. Can J. Zool. 60:241–248.

SAS Institute. 1985. SAS user's guide: statistics. 5th ed. Cary, NC.

Savard, J-P. L. 1991. Waterfowl in the aspen parkland of central British Columbia. Canadian Wildlife Service Technical Report No. 132. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia, Canada.

Smith, K. G. 1977. Distribution of summer birds along a forest moisture gradient in an Ozark watershed. Ecology 60:679–687.

Steen, O. A., and A. L. Roberts. 1988. Guide to wetland ecosystems of the very dry montane interior Douglas-fir subzone eastern Frasier Plateau variant (IDFb2) in the Cariboo Forest Region, British Columbia. B. C. Ministry of Forests and Lands Land Management Report, ISSN 0702-9861; No. 55.

Strickland, J.D.H., and T. R. Parsons. 1968. A practical handbook of seawater analysis. Fisheries Research Board of Canada, Bull. 167.

Tamisier, A. 1976. Diurnal activities of Green-winged Teal and pintail wintering in Louisiana. Wildfowl 27:19–32.

Wetzel, R. G. 1983. Limnology. 2nd. ed. Saunders College Publishing. Philadelphia, PA.