THE WESTERN YELLOW-BREASTED CHAT MODELLING REPORT III

POPULATION VIABILITY IN THE OKANAGAN VALLEY, BC CANADA

Terrasystems Research
609 9th St., Nelson, BC, V1L 3B5, CANADA
lauriecarr@netidea.ca

ELUTIS Modelling and Consulting Inc.
681 Melbourne Ave. Ottawa, ON, K2A 1X4, CANADA
l.tischendorf@elutis.com

Prepared for: Catherine Bishop, Environment Canada, December 2004

Author: Laurie Carr and Dr. Lutz Tischendorf

Photo/image: Bob Graham / Parks Canada

Summary

The Western Yellow-breasted Chat was designated as an "Endangered" Species in 2000 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The species at risk act (SARA) prescribes identification and protection of critical habitat for this species. A comprehensive population and habitat viability analysis was conducted in 2003 for the Yellow-breasted Chat (YBCH) in the Okanagan Valley, BC, based on 2002 field data. This work contributes to and supplements related recovery and conservation efforts. New data from the 2004 field season allows a more precise and updated analysis of the YBCH in the Okanagan Valley. While the 2003 report covered both population and habitat analysis, this report only gives the results of a new population viability analysis.

Metapopulation, spatially explicit population models were used to asses extinction risk and, minimum viable population size, for the YBCH population using the new data for 2004. The results indicate that the YBCH is still endangered by its low population size. The minimum viable population may be larger than 150 breeding pairs, which far exceeds the currently observed population abundance of 38 breeding pairs in the Okanagan Valley. The low population size combined with fragmentation of habitat in the Okanagan valley may cause a lower, but still substantial extinction risk of up to about 25 percent over 100 years. The lower extinction risk (compared to up to about 37 percent over 100 years in the 2003 report) ist primarily attributed to increased dispersal distances in the current models. This exemplifies the negative effect habitat fragmentation can have on population persistence.

List of Contents

<u>Notice</u>

The results provided in this report are subject to an unknown degree of uncertainty. There is substantial uncertainty in the knowledge of demographic data, such as fecundity, survival and dispersal distances. There is also uncertainty in the habitat suitability models, which may be reflected in an incorrect habitat suitability map. This uncertainty and its propagation over time is partly considered in the demographic and environmental stochasticity of the population model. Due to the stochastic nature of the population models, simulation runs were replicated up to 1000 times and results are averages out of those replicate simulation runs. Absolute numbers should be interpreted with caution. Instead trends and differences between different simulation runs (scenarios) are generally more trustworthy. All information used in this work have been discussed with members of the recovery team and verified as well as substituted from the scientific, peer-reviewed literature. The work therefore represents our best possible educated "guess" based on our current knowledge of the biology, life history and habitat requirements for this species.

1 Yellow-breasted Chat *(Icteria virens)*

1.1 Demography

The demographic characteristics for the Yellow-breasted Chat (YBCH) in the Okanagan Valley have been compiled based on published data from the literature and in collaboration with the Recovery Team, in particular Christine Bishop. The data new data from 2004 has been added. See also the following references for life-history information on the YBCH (Ricketts and Ritchison 2000, Booth and Bio 2001, DeSante et al. 2001, Twedt et al. 2001)

Characteristic	Observation	References
Breeding period	mid-May to mid-June	Schadd and Ritchison 1998 Bishop, pers. comm.
Clutch size	3 – 6 eggs, avg. 3.4	Schadd and Ritchison 1998 Bishop, pers. comm.
Broods/year	1	Schadd and Ritchison 1998 Bishop, pers. comm.
Incubation period	11-12 days	Schadd and Ritchison 1998 Bishop, pers. comm.
Fledging period	9 -10 days	Schadd and Ritchison 1998 Bishop, pers. comm.
Maturity	after 1 year	Eckerle and Thompson 2001 Bishop, pers. comm.
Life Span	max: 8 years, avg. unknown	Eckerle and Thompson 2001
Fledging Success	75.38% 70.83%	Bishop, unpubl. Data Bishop, unpubl. Data, 2004
Nesting Success	84% (16% loss by nest predation), lit. 51.48%	Burhans and Thompson 1999 Bishop, unpubl. Data, 2004
Nestling Survival	95% ± 1%	Eckerle and Thompson 2001
BC Population Size	34 pairs (Okanagan) (2002) 4 pairs (Similkameen) (2002)	Bishop, unpubl. data
Stage/Age class	juvenile / adult	Bishop, pers. comm.
#fledglings per territory	3.25 ± 0.17 (Kentucky population), lit. 1.04 ± 0.34 (small patches in Missouri), lit. 1.34 ± 0.36 (larger patches in Missouri), lit. 3.06 ± 0.34 (BC) 1.54 NO SD	Thompson & Nolan 1973 Bishop, unpubl. Data Bishop, unpubl. Data, 2004
Annual Survival	juvenile: 0.3 ± 0.09 (30%) adult: 0.6 ± 0.2 (20%)	estimate based on Thompson & Nolan 1973
Dispersal/Movement	Juvenille: 2.314 km (mean) Adult:0.70 km (mean)	Bishop, unpubl. Data, 2004
Average Territory Size	1.24 ha (Southern Indiana) 0.28 ha	Thompson & Nolan 1973 Bishop, unpubl. Data, 2004
Habitat Requirements	dense thickets around wood edges in low wet places near streams, pond edges, or swamps, overgrown clearings, early successional stages in forests regeneration, grass-herb-shrub layer, key shrub species for nesting is wild rose and a close secondary species is snowberry.	Sedgwick and Knopf 1987 Robinson and Robinson 1999 Bishop, pers. comm.
Threat	very low population size, sensitive to effects of grazing, urban shoreline development, habitat loss	Sedgwick and Knopf 1987
Sex Ratio	unknown, assume 50%	Thompson & Nolan 1973

Table 1: Life history data for the Yellow-breasted Chat

1.2 Population Model

1.2.1 Model Characteristics

The software programs RAMAS® GIS (Akçakaya and Root 2002) was used to model the population dynamics of the Yellow-breasted Chat. RAMAS® GIS provides a comprehensive set of tools to evaluate the viability of a population or a metapopulation, i.e. a population of populations, of which some may become extinct and re-colonized in isolated habitat fragments. The metapopulation model used in this report is spatially explicit and is based on the habitat suitability map as shown in Figure 1. This map has been produced based on the known habitat preferences of the YBCH. (documentation of the habitat suitability model was provided by Olson & Olson) The geographical context for the habitat suitability map is shown in Figure 2.

The habitat suitability map for the YBCH (Figure 1) contains 3 land cover types: no habitat, occupied habitat and unoccupied habitat. The occupied habitat presents those areas, which were identified as habitat and which were occupied by the YBCH in 2002. The unoccupied habitat shows those areas, which meet the known habitat requirements for the YBCH, but which are currently not occupied by this species.

The habitat suitability map as shown in Figure 1 has the following characteristics: north-south extent = 54.2 km, east-west extent = 29.4 km, pixel size = 25 x 25 m, map size = 2168 x 1177 pixels, total area = 1593.48 km², occupied habitat area = 244 ha, unoccupied habitat area = 668 ha.

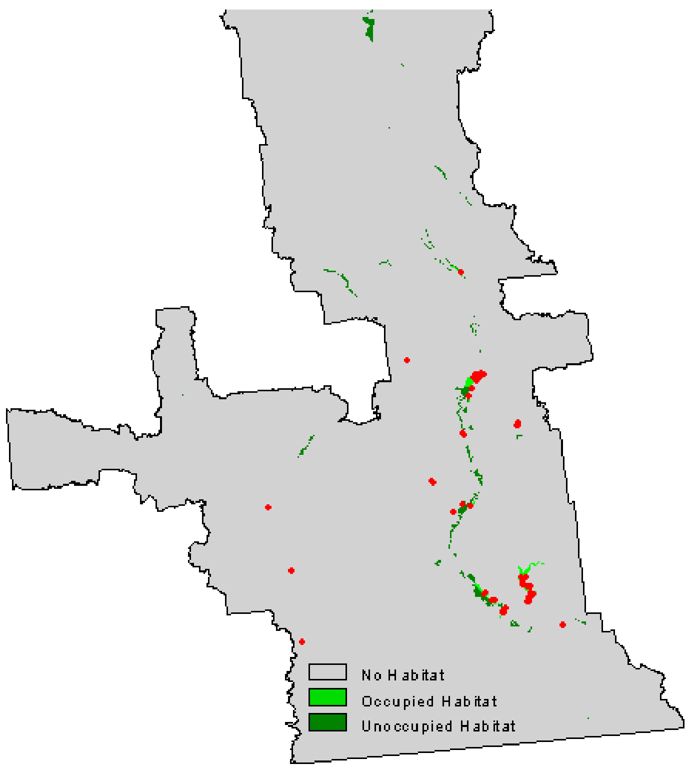


Figure 1: Habitat suitability map for the Yellow-breasted Chat in the Okanagan Valley (29.4 x 54.2 km). The red dots show known breeding sites of the YBCH.

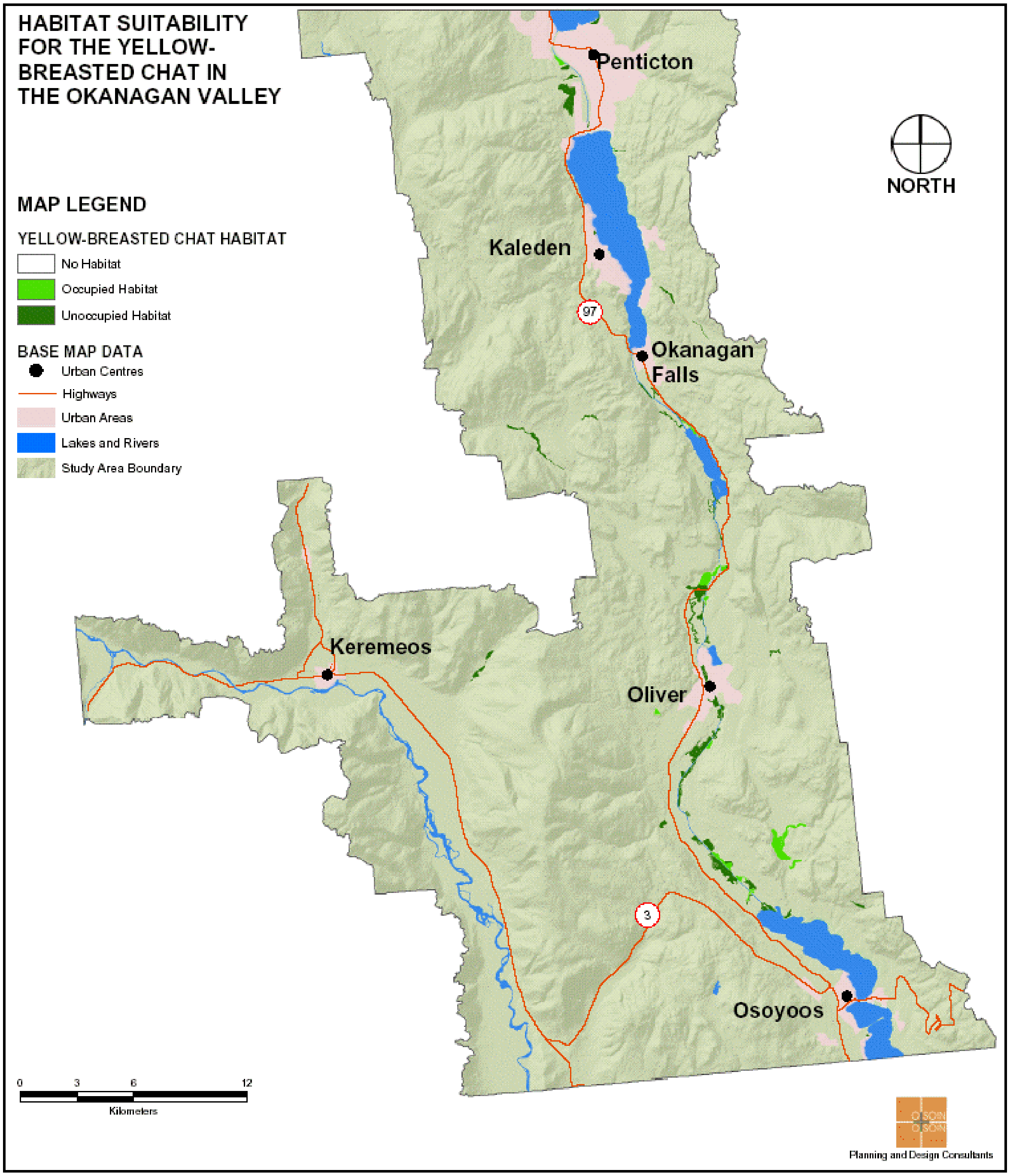


Figure 2: Study area and occurrence range of the YBCH in the Okanagan Valley

1.2.2 Parameter Values

A population model is defined by its conceptual structure (e.g. presence/absence, age classes, individual based) and by its parameter values (Table 2). The latter must be defined based on the biology and life history of the species of interest.

The YBCH fecundity rates per adult female were based on 2004 breeding data from all successful nests, which were not abandoned during the breeding stage. For failed nests, data were excluded, because the birds likely attempted another nest (Bishop, pers. comm.). New estimates of territory size and dispersal distances from mark-recapture studies also occurred in 2004. The annual survival rates used for the YBCH are the same as those in the 2003 report. The rates were based on simulations conducted for the 2003 report (see Tischendorf, 2003).

The population model is a "female only" model and the results are based on the number of females. Since the sex ratio is assumed to be even and no differences in the survival rates for males and females are known, the number of females is a good indicator for the actual number of breeding pairs.

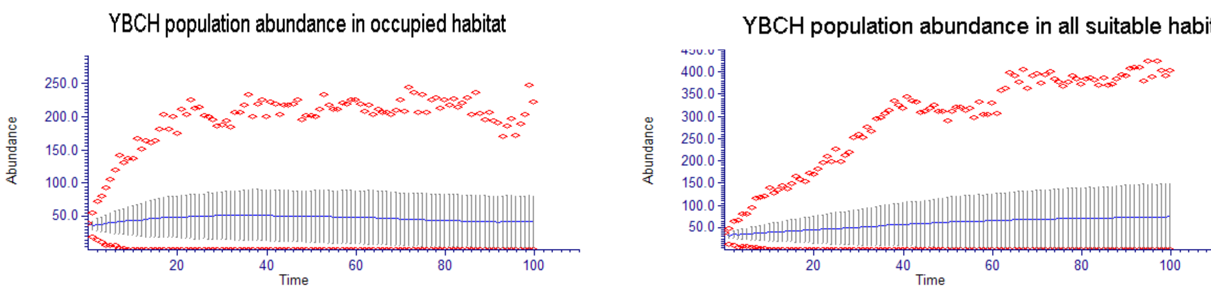
Parameter	Value/Range	Comments
stage classes	juvenile/adult	Bishop, pers. comm.
juvenile fecundity	0	
adult fecundity (female juveniles per female adult)	1.53 ± (10% stddev.) 1.43 no SD	Bishop, unpubl. data 2002 Bishop, unpubl. Data, 2004
juvenile survival	0.30 ± 0.09 (30% stddev.)	estimated after Thompson & Nolan 1973
adult survival	0.60 ± 0.12 (20% stddev.)	estimated after Thompson & Nolan 1973
density dependence	ceiling exp. growth up to carrying capacity of 400 breeding pairs	Bishop, pers. comm.
simulated years	100	
initial population size	38	current known population size in the Okanagan Region
replications	1000	
territory size	1 ha 0.28 ha	Bishop, unpubl. Data, 2004
dispersal	negative exponential up to 1 km Juvenile; 8.148 km (max) Adult: 7.657 km (max) YBCH Average: 0.67 km	Bishop, pers. comm. Bishop, unpubl. Data, 2004
demographic stochasticity	yes	number of survivors and dispersers (emigrants) to be sampled from binomial distributions, number of young from a Poisson distribution. (important for small populations)
environmental stochasticity	lognormal	statistical distribution (normal or lognormal) to be used in sampling random numbers for vital rates

Table 2: Parameter values for the 2003 and 2004 YBCH population models (RAMAS© GIS). Parameter values that have changed for 2004 are marked in red.

1.3 Analysis of the population viability in the Okanagan Valley

1.3.1 Extinction risk

The population model as described in section 1.2 has been applied to the habitat suitability map using RAMAS© GIS in order to estimate the extinction risk of the YBCH for the habitat configuration in the Okanagan valley. The carrying capacity was calculated by dividing the size of each patch by the territory size of the YBCH (0.27 ha). Individuals were allowed to move throughout the landscape according to a negative exponential function, where dispersal to a patch decreases with increasing distance from the source population. The maximum dispersal distance of the YBCH was measured at 8.15 km, and the average dispersal distance was measured at 0.67 km. A fecundity rate of 1.43 (see Table 2) was used. Simulations were conducted on occupied habitat only and on all identified suitable habitat as shown in Figure 1. The initial population on occupied habitat was distributed according to known territory locations (Bishop 2002). The initial population on all suitable habitat (occupied and unoccupied) was distributed proportionally to patch sizes. The results are shown in Figure 3.



a) **Probability of Extinction = 0.252**

b) **Probability of Extinction = 0.251**

Figure 3: Predicted population abundance for the YBCH in the Okanagan valley when residing in currently occupied habitat only (left column) and when using both occupied and unoccupied suitable habitat (right column).

The graph in Figure 3 shows the average population abundance over the time span of 100 years. The vertical lines indicate the range of the standard deviation and the red trapeziums show the observed maximum and minimum values. The simulations predict a final population average of 42 females for the occupied habitat model. This is slightly higher than the present population, which has remained around 38 females over the past four years (bishop, pers. comm.). The simulations predict a growth in the population with a final population average of 74 females for the all (occupied and unoccupied) suitable habitat model. The large standard deviations must be taken into account when interpreting these results. The fluctuations seen in the graphs are the result of the stochastic nature of the model, or in other words, the propagation of uncertainty (in particular the standard deviations around the fecundity and survival rates, see Table 2).

The results of the simulated population dynamics on the habitat suitability map predict the probability of extinction (or extinction risk) is lower for both the occupied (0.252 vs. 0.367) and all suitable habitat (0.251 vs. 0.37) models compared to the 2003 report. Although the extinction risk is lower for both habitat models, the results still indicate a substantial extinction risk for the YBCH over a time span of 100 years.

While the decrease in the fecundity rate from 1.53 to 1.43 had a negative net effect on growth rate, increase observed maximum dispersal distance from 1 (2003) to 8.15 (2004) km, and an average dispersal distance from 0.2 (2003) to 0.67 (2004) km, counteracted this effect and decreased the extinction risk substantially. The extinction risk was calculated as the proportion of replicate simulation runs in which the population became extinct. For example, in the occupied habitat case the population went extinct in 252 out of 1000 replicate simulation runs.

The predicted population abundance for both simulations was far below the actual carrying capacity (877 and 3243 territories for the occupied and all suitable habitat respectively), which indicates that the YBCH may not be able to utilize all available habitat. Even though the dispersal distances were much larger in these simulations compared to those of the 2003 report, the high degree of fragmentation and the north-south dispersion of the habitat patches over a distance of 50 km limit the capability of the YBCH to access all habitats.

1.3.2 Minimum Viable Population

Occupied habitat carrying capacity = 877 territories			All suitable habitat carrying capacity = 3243 territories		
Initial MVP	Final MVP	# of Years for extinction risk < 0.01	Initial MVP	Final MVP	# of Years for extinction risk < 0.01
38	48	15	38	42	15
152	86	75	152	209	140
877 (carrying capacity)	81	100			

Table 3: Predicted population abundance and MVP for the YBCH in the Okanagan valley when residing in currently occupied habitat only (left colum) and when using both occupied and unoccupied suitable habitat (right column).

Table 3 shows the minimum viable population sizes (MVP) for extinction risk less than or equal to 0.01. Three things can be noted from this table. First, as the initial MVP sizes increase, the longer the population will survive with minimal extinction risk. Second, the population in the occupied habitat model will only survive over 100 years with minimum extinction risk even when the initial abundance is at the carrying capacity. Third, the ability for the YBCH to access other habitat then is currently occupied increases population abundance and hence the length of time it can exist with minimal extinction risk (75 vs. 140 years).

2 References

Akçakaya, H.R. and W. Root. 2002. RAMAS Metapop: Viability Analysis for Stage-structured Metapopulations (version 4.0). Applied Biomathematics, Setauket, New York.

Burhans, D. E. and Thompson, F.R. 1999. Habitat patch size and nesting success of Yellow-breasted Chats. Wilson Bulletin. 111(2):210-215.

Booth, B.P and Bio, R.P. 2001. Osoyoos Oxbows, Important bird conservation plan.

DeSante, D.F., M.P. Nott, and D.R. O'Grady. 2001. in ARDEA 89:185-208.

Eckerle, K.P. and Thompson, C.F. 2001.Yellow-breasted Chat. The Birds of North America, No. 575.

Ricketts, M.S. and Ritchison G. 2000. Nesting success of Yellow-breasted Chats: Effects of nest site and territory vegetation structure. Wilson Bulletin. 112(4):510–516.

Robinson, W.D. and Robinson S.K. 1999. Effect of selective logging on the forest bird populations in a fragmented landscape.

Schadd, C.A. and Ritchison, G. 1998. Provisioning of nestlings by male and female Yellow-breasted Chats. Wilson Bulletin. 110(3):398-402.

Sedgwick, J.A. and Knopf, F.L. 1987. Breeding bird response to cattle grazing of a cottonwood bottomland. Journal of Wildlife Management. 51(1):230-237.

Thomson, C.F. and Nolan V. 1973. Population biology of the Yellow-breasted Chat (*Icteria Virens L.*) in southern Indiana. Ecological Monographs. 43:145-171.

Tischendorf, L. 2003. The western yellow breased chat: Population viability and critical habitat in the Okanagan Valley, BC Canada. Environment Canada.

Twedt, D.J., Wilson, R.R., Henne-Kerr, J.L. and Hamilton, R.B. 2001. Nest survival of forest birds in the Mississippi Alluvial Valley. Journal of Wildlife Management. 65(3):450-460.

Tables

Figures