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Improving Counts of Prairie Ponds With Aerial Video and Global Positioning Systems

Major technological advances in tools for habitat surveys have been made since the inception of the Aerial Waterfowl Breeding Ground Population and Habitat Surveys in North America. We developed a method with aerial video, a global positioning system (GPS), and an optical disk recorder to estimate the number of ponds in the prairie pothole region.

Survey With Video

We made aerial videos of 348 km of transects in southern Saskatchewan on 12 and 13 May 1992. The transects consisted of 12 29-km air–ground segments used in the breeding ground survey. The video system consisted of a monochrome camera with a near-infrared (0.81–0.89 µm) bandpass filter, a 5.9-mm wide-angle lens, and a portable video cassette recorder. A Trimble Pathfinder Professional GPS system was interfaced with the video system by a Horita FP-50/TRG GPS-1 time code generator. GPS time was recorded on the audio track of the video tape by the time code generator. Video was made at 460 m above ground level for images with a spatial extent of about 685 m across the transect by 515 m along the transect and a ground resolution element of 1.0 m^2.

Ground crews inspected all wetland basins within the 400 m width of an air–ground segment and recorded the type of wetland basin and water level according to definitions in the survey standard operating procedures.

Video Image Processing

The video images were processed and analyzed by using two software programs (Prepare Video Disk, MarkWet) developed by MicroImages, Inc., Lincoln, Nebraska. The Prepare Video Disk program automated the transfer of video images from tape to a optical disk recorder under control of a personal computer. The video images were organized on the video disk by air–ground segment with the GPS estimate of the latitude and longitude of each video image.

A sample of the video images was used to prepare a training set to develop video interpretation skill and consistent application of pond-counting criteria. The training set included examples of ponds from different video exposure and background habitats (e.g., bare soil, stubble, grassland, and woody vegetation).

The Markwet program allowed selection of a file with video images of an air–ground segment, the display of a video image on a monitor, alignment and location of transect boundaries, and adjustment of image scale. Interactive image thresholding was used to quickly identify potential ponds. The analyst then used tone, size, shape, texture, pattern, and association to decide if a feature was a pond and then marked the pond with the computer mouse.

Video Interpretation Errors

We calculated omission and commission errors in the video interpretation of ponds. The error estimates were calculated from a comparison of the video interpretation of a pond with the ground survey of a pond.

Omission error in the 12 air–ground segments was 0.05–0.36 with a mean of 0.21 (Table 1). Ponds in Type I and Type III wetlands accounted for 92% of the omission errors (Table 2). Ponds in wetland basins with Vestigial and Recessional water levels accounted for 88% of the omission errors. Ponds

in farmyards or ponds with a suspected change in water level between the time of the video survey and the breeding ground survey accounted for the 0.05 (8/168) omission error in ponds in wetland basins with Full or greater water levels.

Commission error in the 12 air–ground segments was 0.07–0.51 with a mean of 0.22 (Table). We detected 277 ponds that were identified as commission errors. Fifty-one percent (n = 141) of the commission errors occurred at wetland basins included in the ground survey. Twenty-two percent (n = 60) of the commission errors occurred at locations not included in the ground survey but identified as wetlands on maps prepared by the National Wetland Inventory of the U.S. Fish and Wildlife Service or interpreted as wetland basins on 1:12,000 scale color-infrared photographs acquired in May 1991 or May 1992. The remaining 73 commission errors resulted from interpretations of roadside ditches (29%), tree shadows (23%), building shadows (19%), dark areas in agricultural fields (11%), shrubs (5%), and unknown features (12%) as ponds.

The actual omission and commission errors in the video interpretation of ponds are probably lower than the error estimates calculated from the comparison of the video interpretation of a pond with the ground survey of a pond. Several factors contributed to the difficulty of estimating the accuracy of the video interpretation of ponds. The factors included a change in pond conditions between the dates of the video and the breeding ground survey, error in the ground survey, and different criteria for counting ponds.

Video System Can Improve Survey

The aerial video system requires a separate flight to make the videos because the aircraft altitude required for identifying ducks does not permit videography of the entire transect width. However, the aerial video system offers several enhancements to the aerial breeding ground survey methodology. Estimates of omission and commission errors can be calculated from a comparison of the video interpretation of ponds with the ground survey of ponds. The video system provides an image of the spatial location of ponds. The location of ponds identified as commission errors from the comparison of the video interpretation with the ground survey could be inspected in the field to verify that these are indeed errors in the video interpretation rather than errors in the ground survey. If ponds are present at these locations, the list of ponds from the ground survey could be updated.

Although not tested in our study, video images can be used to obtain additional useful information on habitat for waterfowl managers, such as pond area, land cover and land use of upland habitats, and the spatial relations of ponds and uplands. Managers should consider alternative sample designs for the video survey of ponds, including the shape and size of sample units, because high sampling variability of ponds among transect segments of the breeding ground survey often complicates the detection of annual changes in pond numbers on a regional basis.

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Table 1. Omission and commission error for video interpretation of the presence of water and pond characteristics on 12 air–ground segments.

egment	Omission (proportion)	Commission (proportion)	Ponds with Vestigial (%)	Types I and III ponds (%)
Shamrock	0.05	0.30	15	83
Hendon	0.09	0.23	16	63
Earl Grey	0.09	0.27	7	42
Cymric	0.11	0.07	8	47
St. Gregor	0.17	0.12	19	52
Hanley	0.21	0.07	12	59
Peterson	0.22	0.10	11	49
Pleasantdale	0.25	0.33	13	43
Craik	0.29	0.13	19	65
Nut Mountain	0.33	0.40	37	72
Tichfield	0.33	0.51	29	80
Marquis	0.36	0.18	27	49
$\bar{x}$	0.21	0.22		
SE	0.03	0.04		

Table 2. Frequency of omission errors for video interpretation by wetland type and water level from ground survey on 12 air–ground segments in southern Saskatechewan in May 1992.

	Wetland type					
Water Level	I	III	IV	Artifical	Stream	Total
Vestigial	54[a]	34	0	2	0	90
	23.79[b]	14.98		0.88	39.65	
	60.00[c]	37.78		2.22		
	78.26[d]	24.29		13.33		
Recessional	14	85	1	9	1	110
	6.17	37.44	0.44	3.96	0.44	48.46
	12.73	77.27	0.91	8.18	0.91	
	20.29	60.71	50.00	60.00	100.00	
Intermediate	1	18	0	0	0	19
	0.44	7.93				8.37
	5.26	94.74				
	1.45	12.86				
Full, flooded	0	3	1	4	0	8
or overflowing		1.32	0.44	1.76		3.52
		37.50	12.50	50.00		
			2.14	50.00	26.67	
Total	69	140	2	15	1	227
	30.40	61.67	0.88	6.61	0.44	100.00

[a] Frequency
[b] Percent
[c] Row percent
[d] Column percent