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GENETIC AND DEMOGRAPHIC CRITERIA FOR DEFINING POPULATION UNITS FOR CONSERVATION: THE VALUE OF CLEAR MESSAGES

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Abstract. In a recent paper on Harlequin Duck (*Histrionicus histrionicus*) interannual site fidelity (Iverson et al. 2004), we concluded that wintering populations were demographically structured at a finer geographic scale than that at which genetic differentiation was observed and that conservation efforts should recognize this degree of demographic independence. In a critique of our study, Pearce and Talbot (2006) contend that our measures of fidelity were not robust and imply that in the face of ''mixed messages'' we failed to appreciate the role of genetic data in defining population units. We recognize, as we did in our original paper, that our methods for quantifying site fidelity have some limitations; however, the patterns in our data are consistent with a considerable body of literature indicating high winter site fidelity in Harlequin Ducks. Moreover, we do not consider differences in the scales at which genetic and demographic structure are expressed to be ''mixed messages,'' given the different spatial and temporal scales at which genetic and contemporary demographic processes operate. We emphasize that a lack of genetic differentiation does not necessarily preclude the existence of contemporary demographic structure with relevance for conservation.

Key words: demography, genetics, Harlequin Duck, Histrionicus histrionicus*, population structure, site fidelity.*

Criterios Demográficos y Genéticos para Definir Unidades Poblacionales para Conservación: el Valor de un Mensaje Claro

Resumen. En una publicación reciente sobre fidelidad internanual al sitio por parte de *Histrionicus histrionicus* (Iverson et al. 2004), concluimos que las poblaciones de invierno se encontraban estructuradas demográficamente a una escala geográfica menor que a la que se observa diferenciación genética, y que los esfuerzos puestos en conservación deberían considerar este grado de independencia demográfica. En una crítica a nuestro estudio, Pearce y Talbot (2006) argumentan que nuestras medidas de fidelidad no fueron robustas, implicando que, enfrentados a ''mensajes mixtos'', nosotros no apreciamos el papel de los datos genéticos en definir unidades poblacionales. Como lo hicimos en nuestra primera publicacioknowledge of the populations, i.e., the scale at which changes in numbers of animals in one area are largely independent of changes occurring in another area. Quantifying the rate and scale of movements among putative population subunits is critical for this understanding (Walters 2000, Clark et al. 2004). In simple terms, in situations where animals move frequently and far, population dynamics are affected by immigration and emigration at relatively large geographic scales. Conversely, for animals that show strong site fidelity, population dynamics at relatively small scales are driven primarily by the intrinsic demographic properties of survival and productivity, i.e., they are demographically independent from other areas. Understanding the degree and scale of demographic independence is critical for identification of appropriate population subunits for conservation. Definition of appropriate management units is difficult (Dizon et al. 1992, Moritz 1994), particularly when applied to migratory animals (Esler 2000, Webster et al. 2002).

We (Iverson et al. 2004) conducted a study of winter site fidelity of Harlequin Ducks (*Histrionicus histrionicus*) in Prince William Sound, Alaska to evaluate the degree and scale of interannual dispersal and consider the subsequent conservation implications. We found high homing rates (>90%) to nonbreeding sites at a scale of kilometers to tens of kilometers and concluded that demographically independent population subunits exist at relatively small scales. Further, we noted that the scale of demographic independence indicated by our data was much smaller than the scale at which genetic differentiation was observed (Lanctot et al. 1999), and that genetic panmixia does not necessarily imply nonexistence of relevant demographic population structuring.

Pearce and Talbot (2006) have two primary criticisms of our paper (Iverson et al. 2004). First,

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they suggest our approach may not have adequately measured site fidelity. Second, they consider mechanisms by which the observed ''mixed message'' (different patterns and scales of genetic versus demographic population structuring) may have arisen, and imply that we did not fully appreciate the value derived from considering multiple markers when evaluating population structure. We address their criticisms below, primarily in relation to the

juvenile Harlequin Ducks accompany their mothers to her wintering area, and Regehr (2003) further discovered that juvenile dispersal during the first winter was on a scale of only tens of kilometers. Also, Iverson and Esler (2006) found that intra-annual winter site fidelity was similar among all age cohorts of females tracked by radio-telemetry. Finally, juveniles constitute a small portion of the overall Harlequin Duck population; therefore, movement patterns of adults have a highly disproportionate effect on the degree of demographic independence.

We do not dispute that some dispersal of adult and juvenile Harlequin Ducks occurs; in fact, we have documented this at a range of spatial scales (Iverson

CLARK, R. G., K. A. HOBSON, J. D. NICHOLS, AND S. BEARHOP. 2004. Avian dispersal and demography: scaling up to the landscape and beyond. Condor 106:717–719.

COOKE, F., G. J. ROBERTSON, C. M. SMITH, R. I. GOUDIE, AND W. S. BOYD. 2000. Survival, emigration, and winter population structure of Harlequin Ducks. Condor 102:137–144.

DIZON, A. E., C. LOCKYER, W. F. PERRIN, D. P. DEMASTER, AND J. SISSON. 1992. Rethinking the stock concept: a phylogeographic approach. Conservation Biology 6:24–36.

ESLER, D. 2000. Applying metapopulation theory to conservation of migratory birds. Conservation Biology 14:366–372.

ESLER, D., T. D. BOWMAN, K. A. TRUST, B. E. BALLACHEY, T. A. DEAN, S. C. JEWETT, AND C. E. O'CLAIR. 2002. Harlequin Duck population recovery following the 'Exxon Valdez' oil spill: progress, process and constraints. Marine Ecology Progress Series 241:271–286.

IVERSON, S. A., AND D. ESLER. 2006. Site fidelity and the demographic implications of winter movements by a migratory bird, the Harlequin Duck. Journal of Avian Biology, in press.

IVERSON, S. A., D. ESLER, AND D. J. RIZZOLO. 2004. Winter philopatry of Harlequin Ducks in Prince William Sound, Alaska. Condor 106:711–715.

LANCTOT, R., B. GOATCHER, K. SCRIBNER, S. TALBOT, B. PIERSON, D. ESLER, AND D. ZWIEFELHOFER. 1999. Harlequin duck recovery from the *Exxon Valdez* oil spill: a population genetics perspective. Auk 116:781–791.

LANDE, R. 1988. Genetics and demography in biological conservation. Science 241:1455–1460.

MORITZ, C. 1994. Defining 'evolutionarily significant unit' for conservation. Trends in Ecology & Evolution 9:373–375.

PEARCE, J. M., AND S. L. TALBOT. 2006. Demography, genetics, and the value of mixed messages. Condor 108:474–479.

REGEHR, H. M. 2003. Survival and movement of postfledging juvenile Harlequin Ducks. Wilson Bulletin 115:423–430.

REGEHR, H. M., C. M. SMITH, B. ARQUILLA, AND F. COOKE. 2001. Post-fledging broods of migratory Harlequin Ducks accompany females to wintering areas. Condor 103:408–412.

ROBERTSON, G. J., F. COOKE, R. I. GOUDIE, AND W. S. BOYD. 1999. Within-year fidelity of Harlequin Ducks to a moulting and wintering area, p. 45–51. *In* R. I. Goudie, M. R. Petersen, and G. J. Robertson [EDS.], Behaviour and ecology of sea ducks. Canadian Wildlife Service Occasional Paper 100. Ottawa, Canada.

ROBERTSON, G. J., F. COOKE, R. I. GOUDIE, AND W. S. BOYD. 2000. Spacing patterns, mating systems, and winter philopatry in Harlequin Ducks. Auk 117:299–307.

WALTERS, J. R. 2000. Dispersal behavior: an ornithological frontier. Condor 102:479–481.

WEBSTER, M. S., P. P. MARRA, S. M. HAIG, S. BENSCH, AND R. T. HOLMES. 2002. Links between worlds: unraveling migratory connectivity. Trends in Ecology & Evolution 17:76–82.

ERRATUM

In Condor 107/4 (November 2005), the paper ''Simultaneous multiple clutches and female breeding success in Mountain Quail,'' by Jeffrey L. Beck et al., contained several miscalculations by the authors. The Results on p. 893, second paragraph, second sentence should read (corrections highlighted in boldface): ''Of these eggs, (%) hatched.'' and the last sentence should read '' - , of eggs (%) in successful nests did not hatch.'' On p. 894, in the last paragraph of the Results, sentences 3–5 should read ''Total egg production for paired females was 284 eggs with (%) hatching. Of the hatched eggs, males hatched % and females hatched %. All 12 females hatched an average of chicks (range: 8–) from both clutches…'' In addition, in the final paragraph of the discussion, the citation for the (USDI Federal Register 2003) should have been for the (**U**). The authors regret these errors.