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CLOSING REMARKS: PIECES OF THE PUZZLE, CIRCLES IN THE STREAM

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“Some quail populations have been on the decline for more than 2 decades; it will require at least that amount of time to understand the causes of those declines and institute corrective measures to reverse those trends.”
(Robel 1993:158)

INTRODUCTION

Individually and collectively, we continue to add pieces to the quail management and research puzzle. Nevertheless, 2 important questions remain: “Are these the right pieces?” “Does the picture on the puzzle we are putting together really make sense?”

Nearly a decade ago, Bob Robel (1993) challenged quail managers and researchers to consider 6 topics, with an assortment of associated questions (Table 1) that he considered were missing from the Quail III program. Since 10 years and 2 National Quail Symposia have now passed, I thought it would be productive to revisit Robel’s remarks, and use them as a basis to organize these closing comments. Most of Robel’s comments and questions emphasized key points of a national strategic planning workshop, which was conducted at Quail III (Brennan 1993), and revisited at Quail IV (Brennan and Carroll 2000). This Quail V wrap-up, for better or worse, provides an opportunity to elaborate on some points made in my “Progress and Frustration” paper, in the context of all North American quails, not just bobwhites (*Colinus virginianus*). This leads me to my first point, which is to lament the apparent lack of research on and interest in the western species of quail, as shown by these proceedings.

PREDATION AND HUNTING

There has been a renewed interest in addressing the effects of predation on quail populations. New technology (Staller et al. *this volume*) finally allows us to obtain a complete inventory of all the predators that attack quail nests. This represents a significant methodological breakthrough. In the past, we could not identify up to 30–40% of nest losses to predators. Obtaining a complete inventory of all predators that attack quail nests, and understanding how nest depredation varies among sites and years, is absolutely crucial for understanding the different predator contexts

in which quail struggle to reproduce. Agency directors (Southeastern Association of Fish and Wildlife Agencies 2000) recently passed a resolution which supports the philosophy that research on quail predation is a valid avenue of investigation, and that predator management to enhance quail productivity is a legitimate pursuit on private lands, if conducted in accordance with state and federal wildlife law and policy. The predator research and management resolution by the Southeastern Association of Fish and Wildlife Agency directors represents a major agency policy change regarding a topic that was once considered the “third rail” of wildlife management.

Despite this progress, the issue of predation, whether in the arena of quail management or research, remains controversial and divisive. Some feel that aggressive predator reduction through management is a potential silver bullet that will provide significant quail hunting opportunities where none presently exist. Others believe that any and all efforts at predator management are a complete and utter waste of time and effort. The truth, and reality, most likely falls somewhere between these 2 polarized views.

I find it curious that biologists and managers often treat predation and hunting as 2 separate issues when they are really the same thing. Quail get killed. To quote Dale McCullough: “Dead is dead.” Yet, somehow, the perception that death by shotgun is different from death by tooth or talon continues to fascinate me. I think that future efforts to develop models of quail predation (that include human hunting pressure) would be extremely fruitful, especially in light of the new insights gained from infrared video camera analysis of nest losses. The impacts of human hunting and losses to predators are, in many ways, 2 different, but adjoining, pieces of the puzzle.

DISEASES AND PARASITES

There seems to be little interest in conducting comprehensive, contemporary research on quail diseases and parasites. In contrast to Robel’s plea (Table 1), agencies, foundations, and private donors seem to have little interest in supporting research on issues related to quail diseases and parasites. There seems to be a perception that while these topics may be interesting, they are not a priority to be addressed at the present time. This may be a mistake. For example, the

CLOSING REMARKS

247

Table 1. Six topical areas and related questions that Robel (1993) considered missing from the Quail III program and proceedings.

Topic	Question
Predation and hunting	<i>In today's setting, what are the effects of predation and hunting on North American quail populations?</i>
Diseases and parasites	<i>How do these events [fragmentation, contamination, exotic species and exposure to domestic livestock] alter the effects of pathogenic organisms on wildlife?</i> <i>How does the stress of human intervention alter the immunosuppression systems of wildlife?</i> <i>Specifically, what are the effects of the above alterations on the susceptibility and vulnerability of quail to diseases and parasites, and how do these factors alter the reproductive responsiveness of North American quail?</i>
Habitat loss	<i>What are the effects of habitat alteration and fragmentation on quail populations in North America?</i> <i>How do farm and forestry policies affect quail populations, and how can these policies be modified or formulated to benefit quail populations in North America?</i> <i>What are the economic values . . . of quail populations and how can those values be melded into state and federal programs to foster healthier populations?</i> <i>How can interest groups help develop these policies and assure that necessary legislative guidelines be adopted and programs initiated?</i> <i>What is the most effective way to develop policies and programs to benefit quail populations in North America?</i>
Long-term data sets	<i>Where are the 20- and 30-year data sets?</i> <i>Without solid data, how can we monitor trends?</i> <i>How can we determine impacts of agricultural policies on quail populations?</i> <i>How can we determine if any of our efforts are beneficial to quail populations?</i>
Changing social values	<i>What will be the economic impact of decreased sales of hunting licenses and equipment on the management of North American quail populations?</i> <i>How will passage of biodiversity legislation affect our efforts to manage habitat for specific species of quail?</i>
Basic biology	<i>How can we really determine the quality of quail habitats when we do not understand the macro- and micro-nutrient needs of quail?</i> <i>How do agricultural chemicals and industrial pollution alter the many metabolic and enzymatic pathways in North American quail?</i>

recent discovery of *Baylisascaris* (a severely debilitating nematode) in northern bobwhites from Kansas (Williams et al. 1997) points out that there is still much to be learned on this front.

HABITAT LOSS

Quail V continues a habitat-based theme that has been constant through the National Quail Symposia. With 17 titles on habitat or landscape-scale investigations, this topic is the backbone of Quail V. Improvements in GIS technology are finally allowing quail researchers to assess broad scale land use dynamics in relation to quail population changes. Using GIS to analyze habitat use and movement data from radio-marked quail also represents a major step forward. Still significant issues related to understanding quail habitat ecology remain. Comparative studies that contrast used and available habitat structure are surprisingly scarce in the bobwhite literature.

Two papers at Quail V raised the ugly possibility that traditional quail habitat management methods may be counter productive, because they can potentially benefit fire ants and therefore have unintended negative consequences for quail. These papers make an interesting point about quail management in the context of the contemporary landscape, which is that many of the tried and true management techniques that worked well in the Stoddard-Rosene era no longer seem effective today. This is probably because we do not yet have a reasonable handle on the habitat-area re-

quirements needed to sustain quail populations, despite our best efforts at conducting research on quail-habitat relationships.

LONG-TERM DATA SETS

Several 20- and 30-year (or longer) data sets called for by Robel (1993) have actually started to appear (Brennan et al. 1997, Brennan et al. 2000, Guthery et al. *this volume*, Palmer et al. *this volume*, Thogmartin et al. *this volume*). The information in these long-term data sets is revealing on several levels. First, data from private lands managed for quail typically show level trends over time, in contrast to other broad scale data from hunter bags or landscape-level monitoring. Second, the presence of cyclicity may be more widespread in quail than we once thought (Thogmartin et al. *this volume*). Third, hunter effort in relation to covey locations may be more valuable at providing crude density estimates than we once thought (Palmer et al. *this volume*). Fourth, temperature and precipitation apparently influence bobwhite productivity in a nonlinear manner, with thresholds and asymptotes that call into question the use of linear models for assessing such dynamics (Guthery et al. *this volume*). These studies, while still relatively short-term compared to the data sets compiled from bag records in the United Kingdom (Tapper 1992), will only become more important and useful over time. It would be especially welcome if more state resource agencies would make a renewed

commitment to collect, analyze, and publish long-term data on quail populations and habitats.

CHANGING SOCIAL VALUES

Despite the recent study by Burger et al. (1999) on quail economics in the Southeast, understanding how changing social values are effecting quail populations remains a backwater of quail research. Note the lack of such material in this volume. Past quail symposia have contained important material on attitudes of quail hunters (Roseberry and Klimstra 1993), their demography (Crews and DeMaso 2000), and the potential effects of altering bag limits (Peterson and Perez 2000). Understanding the changing social context in which quail, and other upland game birds are present, is absolutely critical for developing effective wildlife policy. Yet, there is little activity on this front, despite the fact that such analyses can have huge potential impact on setting bag limits, which are often done more for political than biological reasons (Peterson and Perez 2000).

We are headed down a slippery slope in North America. Modern quail hunting, as Mahoney (*this volume*) states, is moving toward the European model of hunting and away from the American one. This is the Grand Opera that Stoddard predicted. Mahoney raises an interesting point. For example, like Robel (1993) we lament the loss of hunting license and equipment revenues generated from quail hunters (Table 1). However, is it realistic for us to think that we can, or perhaps even should, strive to provide more quail hunting opportunities in light of the habitat fragmentation and declines faced by quail populations? Can we afford, or are we willing to pay, the societal and economic costs to do this? As quail managers and researchers, are we really prepared to tackle these challenges if we are given the dollars and the green light to do so? Is it even possible? Maintaining quail habitat (especially for bobwhites in the southeastern United States) is the one of the most expensive forms of wildlife management in the world, except perhaps for captive breeding of endangered species. For quail hunting to become available to the majority of hunters with modest means and incomes will require a massive change of direction in land use. Such changes can only happen if society is willing to provide incentives, and individuals are willing to make the sacrifices, that will be required to reserve a space for quail on the landscape. Given what I have seen in an early draft of the 2002 Farm Bill, there seems to be virtually nothing coming with respect to incentives for people to implement quail-friendly land use practices on farms, forests, or range lands.

BASIC BIOLOGY

The new availability and economy of molecular tools has set the stage for numerous breakthroughs in understanding the basic biology of quail (Faircloth et al. *this volume*). Unique genetic markers will allow us

to answer questions pertaining to the relatedness of quail broods and coveys, how specific alleles are present (or not) in relation to boom and bust population dynamics, and whether there really are >20 subspecies of northern bobwhite, among other things. Roseberry (1993) raised many of these issues, and to date, only Guthery (1997) and his colleagues have systematically approached quail research with a set of multiple working hypotheses based on theory (Hernández et al. 2002).

Despite the need for basic research, applied studies will probably remain the backbone of quail research in the foreseeable future. This represents opportunity. Empirical studies can, and should, be designed and conducted to test theoretical ideas about how living nature is assembled. Consider, for example, the use of GPS and radiotelemetry technology to analyze pointing dog effectiveness. Taking such data, and evaluating it in light of the theory of hunter-covey dynamics (Radomski and Guthery 2000), elevates such an investigation to a new, more productive level.

IN SUMMARY: CIRCLES IN THE STREAM

Scientific research, when published, is like a stone tossed in the water. Most of the time, research generates small pebbles that make small splashes. Once in a while a big rock from research makes a big splash. In either case, pebbles and rocks generate concentric, circular wave patterns over the surface of the water upon which they are tossed. Research works the same way. Ten years ago, Bob Robel tossed half a dozen stones in the stream of quail research. Today, their circles still resonate. Some of these circles obviously resonate more than others. The challenge is to understand where and how these and many other circles in the stream of quail research fit together and overlap.

We have made significant quail research progress on issues related to predation (but not so much with hunting), habitat losses, and understanding long-term population trends. We have virtually ignored issues related to quail diseases, and how changing societal values are affecting quail populations in North America. We hold hope and promise that modern research tools and techniques will provide new insights into the basic biology and management of these birds that we cherish. We need to make better use of theory as we search to unify our understanding of the factors that regulate and limit wild quail populations. We need to pay more attention to the quails of the American West.

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CLOSING REMARKS

249

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