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SETTING POPULATION OBJECTIVES: BIOLOGICAL, HISTORICAL, AND CONCEPTUAL PERSPECTIVES RELEVANT TO REGIONAL BIRD POPULATION OBJECTIVES

Randy Dettmers [1]

U.S. Fish and Wildlife Service, 300 Westgate Center Drive, Hadley, Massachusetts 01035, USA

Abstract. The development of population objectives as part of the practice of wildlife management and conservation biology has been evolving within these communities for many years. From Aldo Leopold's land ethic with its implicit biological objectives of sustaining healthy wildlife communities, to population recovery targets for endangered species, the rigor and explicitness with which population objectives are developed has been increasing over time. Explicit population objectives are being widely promoted within the bird conservation arena as necessary starting points for developing detailed bird conservation and management plans within decision-making and adaptive management frameworks where population responses are the ultimate measures of success. Many approaches to setting population objectives have been applied throughout the wildlife management and conservation biology disciplines, but population-based approaches (e.g., status quo, historical context, projected future conditions) are currently the most relevant to the development of bird population objectives. The most useful population objectives are quantitative, easily understood, appropriate performance measures at the right scale, measurable (preferably through existing monitoring programs), and robust to uncontrolled environmental variation. However, setting population objectives ultimately forces compromises between objective science and subjective values associated with societal, economic, and cultural issues. Several good examples of the positive value that population objectives can provide to management and conservation efforts are available from endangered species, waterfowl, and big game species.

Key Words: bird conservation, landbirds, population objectives, Partners in Flight.

ESTABLECIMIENTO DE OBJETIVOS PARA POBLACIONES: PERSPECTIVAS BIOLÓGICAS, HISTÓRICAS, Y CONCEPTUALES RELEVANTES A LOS OBJETIVOS PARA LAS POBLACIÓN REGIONAL DEL AVES

Resume. El desarrollo de los objetivos para poblaciones como parte de la práctica de la gerencia de la fauna y de la biología de la conservación se ha estado evolucionando dentro de estas comunidades durante muchos años. Desde los éticas tierra de Aldo Leopold con sus objetivos biológicos implícitos de sostener comunidades sanas de la fauna, a las blancos de la recuperación de la población para las especies en peligro, los objetivos población se están desarrollando con el aumento de rigor y de explicitiness. Objetivos explícitos para aves poblaciones se están siendo ampliamente promovido como punto de partida para el desarrollo de detallados planes de conservación dentro de la toma de decisiones y la gestión adaptable marcos respuestas que la población se miden para evaluar el éxito. Muchos planteamientos respecto al establecimiento de los objetivos de población se han aplicado en el manejo de vida silvestre y la biología de la conservación, pero los enfoques basados en la población son actualmente los más relevantes para el desarrollo de la población de aves objetivos. Los objectivos más útiles poblaciones son cuantitativos, de fácil comprensión, medidas adecuadas de rendimiento en la escala derecha, medibles a través de los programas de monitoreo, y robusto a la variación ambiental incontrolada. Sin embargo, definir los objetivos de población en última instancia, las fuerzas de compromisos entre la ciencia objetiva y subjetiva valores relacionados con la sociedad, económicas y cultura. Varios buenos ejemplos del valor positivo que los objetivos de la población puede aportar a de gestión y los esfuerzos de conservación están disponibles a partir de especies en peligro de extinción, aves acuáticas, y especies de caza mayor.

[1] E-mail: randy_dettmers@fws.gov

INTRODUCTION

Setting population objectives at various scales is a challenging endeavor for bird conservation initiatives given the complexities and uncertainties of the species, partners, and various stakeholders involved in such efforts. The Partners in Flight Science Committee is interested in developing guidelines and recommendations on approaches and tools that are most useful in setting bird population objectives at appropriate scales. The session on population objectives held during the McAllen conference focused on regional scales and reviewing some of the current methods being used to set population objectives at that scale. Such a review of current approaches provided insights into common methods that might be more broadly applicable, and highlighted some of the issues that still need to be addressed regarding development and coordination of population objectives at various scales.

In this paper I provide an overview of the historical context for this topic, review general approaches that have been used throughout wildlife management and conservation biology for developing population objectives, and review functions and characteristics of useful population objectives. This paper also provides positive examples of the value that well-crafted population objectives can provide to management and conservation efforts, including examples from endangered species, waterfowl, and big game species.

HISTORICAL CONTEXT

The concept of setting wildlife population objectives as part of a process for setting the direction for wildlife management and conservation activities has been evolving within the wildlife management community for many decades, and the rigor and explicitness with which population objectives are developed has been increasing over time. In the 1930s–40s, Aldo Leopold's land ethic promoted implicit biological objectives for sustaining healthy biotic communities:

> "Conservation is our effort to understand and preserve the capacity of the land for self-renewal." (Leopold 1949, p. 221)

> "A thing [land-use or management practice] is right when it tends to preserve the integrity, stability, and beauty of the biotic community." (Leopold 1949, pp. 224–225)

Early wildlife management practices in the 1930s–1950s included implicit objectives to restore populations of hunted species through habitat management and hunting regulations (Robinson and Bolin 1989). These efforts focused on setting simple habitat objectives intended to produce desired population levels of game species, which had collateral benefits for non-hunted wildlife populations as well. For example…

> "Many states initiated wildlife management area programs where habitat could be actively managed and wildlife populations restored. As a result, in our state, white-tailed deer, American alligators and wild turkey now thrive." (Florida Fish and Wildlife Conservation Commission 2008)

As populations of game species recovered in the 1950s–1960s, objectives for populations of these species became more explicit and quantitative. Population objectives were more frequently expressed in terms of keeping game populations at or near carrying capacity, keeping densities at a specific level within management zones, or maintaining populations at levels where maximum sustained harvest could be achieved.

These types of population objectives are still in use for some game species, especially big game mammals. For example, the state of Washington's management objectives for the deer species in the state are to maintain stable population growth for white-tailed deer (*Odocoileus virginianus*) but increase the mule deer (*Odocoileus hemionus*) population closer to carrying capacity along with maintaining a minimum of 15 bucks per 100 doe after the hunting season (Washington Department of Fish and Game 2003). An overarching goal of these objectives is to maintain statewide populations for a sustainable annual harvest.

In the late 1960s and early 1970s, increasing concerns for declining rare species led to enactment of the Endangered Species Act, which sets direct population objectives as recovery targets for threatened and endangered species. These recovery plans often set recovery objectives based on the concept of minimum viable populations paired with implicit or explicit habitat objectives for supporting such populations.

For instance, recovery criteria for the Red-cockaded Woodpecker (*Picoides borealis*) include establishment of certain numbers of populations of at least minimum sizes, where the minimum sizes are based on estimates of the population sizes necessary to withstand threats to population viability such as genetic drift, demographic stochasticity, and environmental stochasticity

(U.S. Fish and Wildlife Service 2003). Similarly, the recovery criteria for delisting the Pahrump killifish (*Empetrichthys latos latos*) included establishing at least three populations of at least 500 individuals each, which was considered the minimum size for a viable population (U.S. Fish and Wildlife Service 1980).

During the past 20–25 years, current wildlife conservation and management approaches have been striving to set explicit population objectives for game and nongame species, within adaptive management contexts and at multiple spatial scales. With the advent of, and refinements to, the North American Waterfowl Management Plan (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1986, North American Waterfowl Management Plan, Plan Committee 2004a,b), Partners in Flight (Pashley et al. 2000, Rich et al. 2004), and other bird conservation initiatives (Brown et al. 2000, Kushlan et al. 2002, Dimmick et al. 2002, Woodcock Task Force 2008), explicit population objectives have been widely promoted as necessary starting points for developing detailed bird conservation and management plans within decision-making and adaptive management frameworks where population responses are the ultimate measures of success.

COMMONLY USED APPROACHES FOR SETTING POPULATION OBJECTIVES

Sanderson (2006) reviewed approaches that have been used to set population objectives across a wide variety of conservation efforts and numerous animal taxa. He identified 18 different approaches to setting objectives and grouped these into three main categories based on the intended beneficiary: 1) population-based approaches, which seek to conserve populations themselves, 2) population-as-surrogate approaches, which use populations of animals to conserve a larger set of conservation targets such communities or ecosystems, and 3) human-oriented approaches, which focus on the various self-interests humans have for conserving animals. Population-based approaches are the most relevant to setting bird population objectives as currently approached by Partners in Flight and the other bird conservation initiatives. So, I will focus on these approaches, but for further description of the other approaches, see Sanderson (2006).

The specific approaches identified by Sanderson within the population-based category include the following, which are presented in relative order from approaches that set minimal objectives to maximum objectives: 1) evolutionary potential (maintaining sufficient genetic diversity to allow a species to continue adapting to changing environmental conditions), 2) demographic sustainability (self-sustaining minimum viable population), 3) ecological function (maintaining a population at a density where it continues its normal functions within its ecological community, including intra- and inter-specific relationships and interactions), 4) status quo (maintain the present state), 5) historic baselines (restore a population to some historic condition), and 6) maximum size (as large of a population as possible). One additional relevant approach that could be added to this category is one that might be called 7) future conditions (based on projected future conditions of habitat and other environmental factors). Such an approach establishes population objectives based on estimates of what future habitat capacity and other conditions will be and relates these future conditions to population size.

All of these population-based approaches could be appropriate to consider for setting bird population objectives. However, given that all of the bird conservation initiatives have goals to sustain bird populations at levels above mere minimums and to maintain healthy and abundant bird populations, the specific approaches that consider status quo, historic baselines, future conditions, and maximum levels are the approaches with the most relevance to setting bird populations within the context of how Partners in Flight and the other bird initiatives approach bird conservation.

FUNCTIONS AND CHARACTERISTICS OF POPULATION OBJECTIVES

The functions and characteristics of useful population objectives have been identified and discussed elsewhere (see North American Waterfowl Management Plan 2004a, Bart et al. 2005) and by other papers in this Proceedings. Therefore I will only briefly reiterate that population objectives function: 1) as communication and marketing tools to demonstrate the need for conservation and catalyze actions, 2) in setting the foundation for strategic conservation planning by establishing the biological targets which processes such as adaptive management and conservation design strive to achieve, and 3) as performance metrics for assessing conservation accomplishments. In addition, population objectives are most useful when they incorporate as many of the following characteristics as possible (Bart et al. 2005), which relate to the functions mentioned above:

- Communicable and understandable
- Consistent with other conservation plans
- Quantitative

- Measurable (preferably through existing monitoring programs)
- Fit the right scale as performance measures
- Comparable among regions and linked across scales
- Robust to uncontrolled environmental variation

ABUNDANCE AND PERFORMANCE-BASED OBJECTIVES

Bird conservation initiatives and Joint Ventures are encouraging the development of quantitative population objectives at various scales because they are useful in strategic conservation planning processes and as performance metrics. Quantitative population objectives can be characterizes as being either abundance-based objectives or performance-based objectives. Abundance-based objectives are developed using metrics that relate to the size of the population, such as specific targets for the total number of individuals in the population or a goal of increasing the current population by a certain percentage. Performance-based objectives incorporate metrics that relate to demographic or physiological parameters, such as recruitment rates, survival rates, or fat reserves.

Performance-based objectives are most relevant as performance indicators at local and regional scales where they have good potential to measure the performance of management activities on particular sites. They are not well-suited to measure performance across very large spatial extents because they require more intensive efforts to monitor and this quickly becomes prohibitive at larger scales. They also are not as appropriate as a basis for developing quantitative habitat objectives. However, this type of objective usually matches well with the temporal scale of management decisions and is very useful, if not essential, in helping to identify limiting factors.

Abundance-based objectives are, by nature, arbitrary, because they reflect value-based statements by those setting the objectives and because one of their primary purposes is to foster consensus and collective action among partners. They are also useful as a basis for developing quantitative habitat objectives.

These objectives are most effective when they are grounded in reality and informed by science. Mechanisms should also be available to account for uncontrolled factors, such as environmental variation, when comparing monitoring results with abundance-based objectives. This category of quantitative objectives is best suited for serving as a performance indicator (i.e., metric for measuring progress toward a goal or measuring a response to management actions) at the largest geographic extents (e.g., continental scale) and has low potential to assess performance of management activities at local scales because of the influence that factors outside of the local area can have on abundance-related metrics.

A comprehensive population objective at a regional scale would ideally include both abundance-based and performance-based objectives, although in practice it can be difficult to incorporate both types of objectives into a regional population objective. Many of the concepts regarding abundance- and performance-based objectives have been developed by Rex Johnson and his colleagues with the Habitat and Population Evaluation Team of the Division of Migratory Birds, U.S. Fish and Wildlife Service.

THE ROLES OF SCIENCE AND OF VALUES

Many potential answers exist to the question of what is the most appropriate population objective at a given spatial scale, depending on the interests, perspectives, and insights of the partners and stakeholders involved in the process of developing objectives. Science plays a necessary role in setting population objectives by providing information on the consequences of alternative objectives being considered and by quantifying concepts such as "viability" and "capacity" in relation to population sustainability and adequate habitat quantity to support populations.

Scientists typically want to rely as much as possible on scientific information for setting population objectives, but science by itself often is not sufficient to decide which alternative is preferred. Setting population objectives forces compromises between objective science and subjective values associated with societal, economic, and cultural issues. Ultimately, human values and preferences set against the realities of current ecological, economic, and sociopolitical factors determine which alternatives for population objectives are most appropriate and acceptable for the wildlife species and human groups involved in the process. Subjective values will play a significant role if a wide range of perspectives is represented in the group making the decision about objectives.

EXAMPLES OF POPULATION OBJECTIVES FROM OTHER CONTEXTS

The following examples of population objectives from endangered species, waterfowl, and big game species provide examples of the positive value that population objectives can provide to management and conservation efforts.

Endangered species programs typically establish recovery goals which indicate when a species should be evaluated for de-listing or down-listing (e. g., U.S. Fish and Wildlife Service 1980, 2003). These recovery goals are the population objectives used by endangered species programs as their conservation targets. Recovery goals are often set using a demographic sustainability approach where a minimum viable population or some minimal self-sustaining population is the goal for recovery purposes. Although Partners in Flight and the other bird conservation initiatives typically aim for more liberal objectives than what are usually set as endangered species recovery goals, recovery goals do provide some useful and instructive examples of clear population objectives that help communicate the conservation need for the species and serve as good metrics for assessing progress toward meeting the goal.

Kirtland's Warbler (*Dendroica kirtlandii*)

Kirtland's Warbler is a federally endangered bird in the U.S. and has a recovery goal of 1000 breeding pairs (U.S. Fish and Wildlife Service 1978). A population objective in terms of the total size of the breeding population is a good metric for this species because its small population and limited breeding distribution makes it possible to complete a true census of the breeding population. This population objective also provides a good basis for developing habitat objectives because of the knowledge researchers have developed about the habitat preferences and habitat relationships of this bird. The habitat objective for this species is to constantly maintain 36 000–40 000 acres of breeding habitat within a larger area of 140 000 acres of jack pine (*Pinus banksiana*), which is to be managed through rotational cutting to maintain desired amounts of suitable habitat. These population and habitat objectives have provided clear, quantitative goals for recovery of this endangered species, making clear the management activities that need to be undertaken in order to reach those goals. The scale for these objectives is very similar to the regional scale that is of interest to the bird conservation initiatives for setting regional population objectives.

Waterfowl

The North American Waterfowl Management Plan (NAWMP) provides an excellent example of setting population objectives in a very useful way that satisfies many of the purposes of population objectives (North American Waterfowl Management Plan, Plan Committee 2004a,b). NAWMP has been described in detail elsewhere and is discussed in other papers from this session, so discussion will be brief here. NAWMP provides abundance-based quantitative population objectives at the continental and regional scales that reflect a historic baseline and consensus among stakeholders of the waterfowl community.

These population objectives provide clear metrics for assessing progress toward management goals and provide a measure of the system state for monitoring responses of waterfowl populations to management actions. The NAWMP regional population objectives are also used as starting points to inform quantitative models that link the population objectives to habitat objectives. While NAWMP has developed a model system for developing quantitative bird population and habitat objectives, a commonly agreed upon method for allocating objectives at the continental scale to regional scales has not been found. This step of translating objectives across scales is one that provides a challenge for all bird conservation initiatives.

Moose (*Alces alces*)

An interesting and informative example from large game management comes from population objectives set for moose in the state of Maine. During their 1985 planning process to set objectives for moose, the Maine Department of Inland Fisheries and Wildlife (MDIFW) set quantitative moose objectives based on desired population size, harvest rates, and non-consumptive components related to wildlife viewing. The population size goal was to maintain the state-wide population at the 1985 level of 21 150, with a corresponding harvest goal of 1000–1400 individuals per year, which was the estimated amount needed to maintain a stable population. The non-consumptive goal was to decrease unsuccessful viewing trips by 50% (Morris 1999).

In their most recent planning process, MDIFW updated their objectives to cover the period of 2000–2015 and stepped the objectives down to individual wildlife management districts (Morris 2002). Population size objectives were thus stated in terms of a percentage of the carrying capacity in the different management zones (e.g., 55–65% of carrying capacity for management districts 1–4). The harvest objective is stated in terms of "maximizing" hunting opportunities, which is translated into a percentage of mature bulls in the population. Non-consumptive issues were updated to include reducing moose/vehicle collisions in some management districts, which translated into a goal of reducing the population by 33% in those districts. They also set objectives for providing viewing opportunities in other management districts, where this non-consumptive objective dovetailed with the harvest objective.

These moose population objectives provide another good example of quantitative objectives that help communicate a variety of needs for managing the moose population in Maine while also serving as good metrics for measuring progress toward the management goals and for assessing responses to changes in management actions.

CONCLUSION

Population objectives have been implicit in wildlife management from its beginning and have become increasingly explicit and quantitative as science in the field has progressed. Across wildlife management and conservation biology disciplines, a wide variety of approaches have been applied to the process of setting population objectives. Within the bird conservation realm, population-based approaches fitting into the categories of status quo, historic baseline, and projected future condition are currently the most frequently employed approached.

As the process continues to identify the most appropriate methods for developing regional bird population objectives for landbirds and other bird taxa, and as Partners in Flight moves toward crafting guidance and recommendations on this topic, several key questions will need to be addressed: 1) can population objectives be linked and reconciled across continental and regional scales?, and 2) are there common elements in methods for setting regional bird population objectives that should be included in any effort to develop regional objectives?

Currently, Partners in Flight has set continental population objectives that are based on historic bird population trends, are quantitatively expressed in terms of proportional change relative to current population levels, and are idealistic in terms of expressing a desired state that represents returning many bird populations to higher levels known to exist about 40 years ago.

The current examples of methods that are being tested for developing regional landbird population objectives indicate that these methods are basing objectives, not just on historic bird population trends, but also on assessments of current and anticipated habitat capacity within the regions being considered. Thus, objectives being developed through these methods can be described as more realistic than idealistic. They also are typically being expressed in quantitative measures of population size, rather than in terms of proportions of current populations. These differences between characteristics of continental and regional objectives will need to be rectified if Partners in Flight desires to have objectives at both of these scales that are completely reconcilable and can be transparently translated between the two scales. Questions exist as to whether or to what degree continental and regional population objectives need to be completely linked, as well as to how objectives developed at the continental scale should inform objectives developed at the regional scale and visa versa.

A variety of methods for developing regional population objectives are currently being applied in various Joint Ventures and Bird Conservation Regions across the United States. Commonalities among these methods likely reflect elements that are critical to developing sound regional landbird population objectives while the differences between them will need to be addressed if population objectives are to be developed so that they are reconcilable and transparent across spatial scales and spatial extents.

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