Channel Islands National Park Landbird Monitoring Program Review
April 18-19, 2000

Kathryn McEachern
USGS/BRD/WERC, Channel Islands Field Station

U.S. Geological Survey
Biological Resources Division
Western Ecological Research Station

April, 2000

Channel Islands National Park Landbird Monitoring Program Review

Introduction

Channel Islands National Park implemented a biological monitoring program in the late 1980's, with long-term funding through the National Park Service (NPS) Inventory and Monitoring program. Twelve different monitoring protocols were designed to describe communities and populations and track long-term trends in terrestrial and marine systems of the park. Protocols that have been implemented include vegetation, landbirds, small mammals, herpetofauna, seabirds, rocky intertidal systems, kelp forests, beaches and sandy lagoons, and weather. Between 5 and 15 years of data have been collected across these protocols, and some of them have sufficient information for trend analysis. An important component of the Channel Islands monitoring program is periodic review of the data, to determine whether adjustments in sampling techniques, study design or data handling could make the program better. A group of scientists reviewed the kelp forest program in 1996, and the landbird, vegetation, seabird, and rocky intertidal programs are being reviewed in 2000.

A technical review of the landbird program was held April 18-19, 2000. The group used the written landbird monitoring protocols for Anacapa, Santa Barbara and San Miguel Islands (van Riper et al, 1988) and Santa Rosa Island (Super et al, 1991), an example of a landbird monitoring annual report (Coonan, 1996), and a summary of bird abundance data collected by the Channel Islands program 1993-1998, (Fancy, 2000, Attachment 1) as the basis for discussion. Meeting participants were:

Dr. John Sauer, USGS-BRD, Patuxent Wildlife Res. Center
Dr. David DeSante, Institute for Bird Populations, Point Reyes Station, CA
Dr. Rodney Siegel, Institute for Bird Populations, Point Reyes Station, CA
Dr. Jon Bart, USGS-BRD, Boise State University, Idaho
Dr. C. J. Ralph, USDA Forest Service
Robert Kuntz, North Cascades National Park
Dr. Steven Fancy, National Park Service, Natural Resource Information Division
Dr. Paul Geissler, USGS-BRD Science Staff
Dr. Kathryn McEachern, USGS-BRD, Channel Islands Field Station
Tim Coonan, Channel Islands National Park
Kate Faulkner, Channel Islands National Park
Linda Dye, Channel Islands National Park

Specific objectives of the review were to:

- Ensure that the monitoring protocol is achieving the park's objectives for its monitoring program;
- Identify the level of temporal change that can be detected with the existing protocol and the level of confidence in detecting change;
- Identify opportunities and techniques to improve power and efficiency of monitoring;
- Accommodate improvements in technology (such as data collection technology, GPS, database management software), as appropriate, into the protocols; and
- Foster the cross-linking of protocols and integration across monitoring programs to help the Park better understand ecosystem dynamics.

A revised landbird monitoring protocol handbook with a sample design that incorporates a more powerful methodology, is more aligned with other national landbird monitoring programs, and better integrated with the vegetation monitoring, will be written after follow-up discussions with the team reviewing the Channel Islands vegetation monitoring program in September, 2000.

Review team comments on the existing program

Original program goals

Setting clear, unambiguous scientific and management goals for any monitoring program is a necessary first step in program design. Scientific and management goals were stated in both protocol design documents (van Riper et al 1988, Super et al 1991), but other expectations of the program have developed over the years that were not actually part of the original design criteria. Therefore, considerable time was spent articulating the original goals of the landbird monitoring protocols so that the sample design, field methods and resulting data could be realistically evaluated against the design objectives. Original program goals were:

A. Determine annual relative abundance of breeding landbirds in the breeding and non-breeding seasons.
B. Detect changes in relative abundance and distribution in the breeding and non-breeding seasons.
C. Link changes in abundance to changes in habitat resources.
D. Document population dynamics for three indicator species, one each from the three major foraging guilds (American kestral - carnivore, song sparrow - granivore, orange-crowned warbler - insectivore).

Hindsight shows that a clear statement of program goals needs to be carried with the program over the years, particularly as the program is represented to management, scientists, and people collecting the data. Since the Channel Islands landbird monitoring program has been supervised throughout by Tim Coonan, loss of the original vision has not been a large problem. In the experience of several of the reviewers, however, loss of original thinking has been a confounding factor in ensuring consistency in programs run over many years. Periodic scientific and management program reviews should be conducted, and this review should not be the last one for the Channel Islands monitoring program.

Evaluation of the current program against original goals

The Channel Islands landbird monitoring program has produced a high-quality, internally consistent data set on bird abundance over many years. The Park can be proud of this effort, and should continue the program since it is only one of a few land-based programs nationwide with such good data. These technical review criticisms should not detract from the overall recognition that this is a good program that can serve as a model for others.

It should be noted at the outset that a slight, but important, modification was made to the sampling protocol designed by van Riper et al in 1988. Rather than recording birds within 100 meters of the transect, any bird seen or heard was recorded along with its estimated distance in meters from the transect midline. This addition to the established protocol was made by Tim Coonan, Channel Islands Terrestrial Biologist, in order to increase the value of the transect and

point count data. The distance measurement allows the estimation of absolute instead of relative abundance, removing the effects of observer, vegetation and other factors on detectability and on the abundance estimate.

Thus bird observations along transects for Santa Barbara, Anacapa, and San Miguel were not truncated at 100 meters as recommended in the 1988 protocol, but were unconstrained by distance and recorded with an associated distance. Data reported in the annual reports were truncated at 100 meters to remain true to the original protocol, recognizing that the additional information might be useful in future analyses. When Steve Fancy (2000) did the long-term analyses, he used the whole set of observations and their associated distances. Detectability curves were calculated for each species with sufficient data in the multi-year data set, and species' abundances were adjusted by these curves (Fancy 2000).

Goal A. Determine annual relative abundance of breeding landbirds in the breeding and non-breeding seasons.

The monitoring program, with the adjustment for distance sampling along transects, does provide an annual estimate of absolute abundance of both breeding and non-breeding birds and the data can be used to construct trends. But because sample locations were subjectively chosen, inferences from the data can only be made about the places along transects that are sampled, rather than being extrapolated to the whole island. Sample transects on Santa Barbara, Anacapa and San Miguel islands were not selected with a random design; that is, with every area on the island having a chance of being selected. Instead, existing trails were used as the sample transects, and they sample a biased, subjectively chosen portion of the landscape. Sampling was initially restricted to trails because of concern for fragile vegetation. This constraint on off trail sampling has been relaxed recently, as park staff have gained more experience with the monitoring program, and since the islands have had more time to recover from grazing. The Santa Rosa Island point count stations were not selected at random, either. Therefore, the 1993-1999 data cannot be used to make island-wide inferences.

The 1988 protocol for Santa Barbara, Anacapa and San Miguel Islands included off-trail counts every five years using distance estimation (transects and point count stations) to develop correction factors for the on-trail surveys. Those counts were not done because of lack of funding for the additional effort. Annual counts made at locations selected at random across each island would allow adjustment of the on-trail counts, for greater confidence in any island-wide inferences made about trends in bird abundance. For greatest confidence in any inferences made using such a hybrid sample scheme, off-trail counts should be made annually, rather than occasionally.

Goal B. Detect changes in relative abundance and distribution in the breeding and non-breeding seasons.

The data can be used to detect changes in bird densities for those areas along transects or near point count stations. The data cannot detect changes in bird distribution because the field sample design is not spatially structured. On Santa Barbara, Anacapa and San Miguel Islands sample locations are not referenced to a habitat map, the sample transects traverse several different habitats thereby averaging the bird observations across habitats, and the sample transects are not co-located with any vegetation or habitat samples. On Santa Rosa Island, point count stations were co-located with vegetation transects, but these stations were not chosen at

random from the suite of vegetation transects. Again, because the sample design lacks this random component, habitat-wide or island-wide inferences cannot be made from the data.

Goal C. Link changes in abundance to changes in habitat resources.

The data cannot be used to link changes in abundance to changes in habitats or other biota of the islands for two reasons. First, the bird sample locations are not referenced to habitat and co-located with vegetation samples, or sample locations for any of the other terrestrial monitoring programs. Second, the sample design lacks the random component which would have allowed extrapolation of trends to habitats island-wide.

Goal D. Document population dynamics for three indicator species, one each from the three major foraging guilds (American kestral - carnivore, song sparrow - granivore, orange-crowned warbler - insectivore).

The monitoring protocol for indicator species was not implemented because of labor and funding constraints.

Conclusions

This program has a high-quality eight-year run of data on landbird abundance that can be used to construct trends. The lack of funding for periodic off-trail counts and indicator species sampling has limited the extent to which the data can be used. Inferences about bird trends are limited to those areas along transects or near point count stations because the sample locations were not chosen at random and the recommended additional five-year periodic data adjustment counts were not made. Habitat-by-habitat analyses cannot be made because the sample locations were not co-located with or referenced to vegetation or habitat samples. Causal mechanisms or factors that may be associated with change are not demonstrated by the monitoring program, because population-level indicator species productivity sampling was not implemented.

Recommendations for future monitoring

Amended program goals

The original landbird monitoring program goals centered on tracking changes in bird abundance over time. The program could be made stronger with the addition of a spatial, habitat-based sampling component, and by strengthening the ability to use data to identify environmental factors or processes that may be associated with trends. Monitoring goals should support the Park's goals. Therefore, the team recommends that the Park consider changing the program goals to the following:

Goal A. Estimate annual abundance of breeeding and nonbreeding landbirds.

Goal B. Detect temporal changes in landbird abundance, distribution and vital rates. Annual abundance estimates by habitat strata and sections of an island would detect changes signaling threats to the landbird populations. Monitoring vital rates (natility and mortality) would provide insight into the probable causes of any population declines and may indicate problems before abundance is impacted.

Goal C. Predict probable trends in landbird abundance and welfare, to provide early warning of potential threats to populations.

Goal D. Link changes in landbird abundance to changes in vegetation and other habitat resources. The linkages would provide insight into the interrelationships among components and help detect common threats.

Goal E. Identify likely source and sink habitats.

Goal F. Provide demographic information on birds in the community.

Goal G. Estimate viability of endemics. The estimates would be based on annual estimates of landbird abundance, distribution and vital rates.

Goal H. Suggest cause and effect relationships among Channel Islands terrestrial monitoring program disciplines.

Goal I. Provide information at the habitat scale so that it is useful for management.

New program design

A new, spatially structured, stratified random sample design should be developed for estimating landbird abundance on all five NPS islands. Both the old and new locations should be sampled for three years, and then the new design can be used alone. Density data collected during the three years of overlap can be used to adjust (or crosswalk) the old data with the new, so that the program can continue to use the full data set from 1993 onwards in trend analyses. Additionally, demographic data should be collected so that mechanisms related to changes in bird abundance can be identified. Specific recommendations for the program follow.

Transition from the old to the new protocols

- Sample using both the old (1993-2000) and new (2001 onwards) methods for a period of 3 years to develop a correction factor for the old data. If simultaneous sampling is not done, it will be impossible to use the 1993-2000 data in trend analyses.
- Variables to compare between methods: a) total counts per transect or VCP for those species with so few observations that detection curves cannot be constructed; b) old vs. new estimates of abundance; c) numbers of species not detected by the new method (these would be the numerically rare species; there will probably be so few species in this category that failure to detect them is not a great concern).

Sample design

- Use variable circular plots (VCP's) as the basic field unit for the new landbird density monitoring program. Data from these samples can be adjusted using detectability functions (Fancy and Sauer 2000) to provide an estimate of density for bird species with a large number of observations. For species with a very large number of observations, the adjusted densities approach the true density. In the absence of a sufficient sample size for any given species, the non-adjusted total counts can be used.
- The observer should estimate distance to each bird detected.
- The sample design should provide extensive coverage of the island.

- Stratify sample locations across the islands by some landscape characteristic so that habitat-level analyses can be made.
- Co-locate landbird sample locations with the Channel Islands vegetation monitoring program transects and other monitoring sites to the degree feasible.
- Use a simple random sample design for the smaller islands (Santa Barbara and Anacapa), and cluster samples on the larger islands (Santa Rosa, Santa Cruz). San Miguel is at about the maximum size where a simple random sample allocation might work. Either scheme could be used for San Miguel (see below).

Cluster sampling

- Cluster sampling involves locating 5 or more VCP's along transects. The merits of a cluster sample design is that more points can be sampled per morning by reducing the travel time between points. Such a design places certain statistical limitations on the data analysis. For a habitat-by-habitat analysis, points should be grouped by habitat along any transects that traverse more than one habitat type. This grouping reduces the degrees of freedom in the analysis. In general, this tradeoff is worth it when many more points can be sampled.
- Try a simple random sample location scheme for San Miguel and map out the shortest travel times between VCP's. Use this layout if it is about as efficient as a cluster transect layout in terms of points sampled per morning.
- The distance between VCP's along cluster transects should be scaled to the landscape terrain so that the time spent walking between them is minimal and the chance of double-counting birds is low. In open terrain use a 250-meter interval between points. In rough terrain or dense vegetation cover, a 150- to 200-meter interval is appropriate.
- Locate the transect across the prevailing gradient of the landscape to minimize between-transect variance (e.g. – uphill rather than along the contour).

Power analysis

- A common approach in sample design is to analyze a preliminary data set to determine how many samples are needed to detect change with a given level of confidence, and to then allocate that number of samples. Such an approach may be fruitless where there are fixed resources for monitoring, as at the Channel Islands. Instead, the data should be analyzed to determine what power they have for estimating density and detecting change for selected (or all) species or species guilds. The park and the scientific community can then decide whether this level of statistical power is acceptable for their needs. (Dr. Paul Geissler, USGS-BRD Statistician, has offered to use the adjusted 1993-1998 landbird data in such a power analysis.)
- Managers might want to have a "trigger point" or threshold of change at which more intensive management action or directed research is undertaken. While this is a good idea, it is a difficult thing to do. One approach might be to use power analysis in a comparison of baseline to later monitoring data, or in an analysis of a trend line over many years. If changes of a certain magnitude are seen, some action is triggered. The problem is that it is difficult to identify a biologically meaningful amount of change in a relatively short period of time, particularly in highly variable Mediterranean ecosystems. Another problem is that important changes might be missed in a sparse data set, as with some of the birds of the islands. Relying solely on a power-induced trigger might be misleading for those species.

- Another approach might be to graph and visually inspect the data, looking for deviations from a pattern, downward trends or wild fluctuations in abundances or in variances. One goal of the annual reporting should be to look for "red flags" indicating trouble with a species or with a data collection scheme.

Sample season

- Dropping the fall sampling season might provide time for demographic sampling and report preparation. However, the fall samples may provide important seasonal data on mortality and habitat use.
- Conduct a pilot study to determine whether birds utilize different habitats in summer and fall. Sample bird density at the VCP locations early November through December in one year. Compare results with the summer census to see if differences in mortality or movement can be ascribed to habitat. If a period of high mortality is not apparent, or if a pronounced habitat shift is not made, the fall sampling might be dropped.

Frequency of sampling

- Continue annual sampling. If the program scales back to sample every 2-3 years it will be hard to get enough data to develop a temporal trend. It takes 8-10 years of data to get a trend line with good statistical power, and perhaps longer in highly variable Mediterranean-type environments. Sampling at longer intervals would mean that the program could not produce "good" trend data for 20 years or more.
- An alternative to annual sampling that is used in some areas is a rotating panel design (sample a subset of the points each year so that over a period of 5 years all points get sampled; each year, sample one-third of the points sampled in the previous year). The tradeoff with this design is that it provides annual information on habitat use, but it sacrifices information on trends. A rotating panel design would not be good for Channel Islands, where a major goal is to get trend information in all of the terrestrial monitoring programs.

Sample interval and times

- Sampling begins within 15 minutes of sunrise and ends 4 hours later in the existing landbird monitoring program. Use this interval in the new program for all islands.
- Record all birds detected at the VCP for a total of 5 minutes. Record detections in the first 3 minutes separately from the last 2 minutes, so that the data can be compared with regional breeding bird survey (BBS) data. (The BBS protocol uses a 3 minute recording time.)

Switching between observers

- One of the best features of the Channel Islands landbird density data set is its internal consistency: the data were collected almost exclusively by one person (Tim Coonan). The observer bias is minimal, and the number of computations that have to be done to develop detectability curves for each bird species-by-observer combination is greatly reduced. Using the same person to conduct all of the sampling is ideal in a long-term monitoring program.
- Always cross-train when switching to new observers. Sample a subset of points simultaneously to make sure that birds are identified correctly, most birds are detected, the observer stops in the right spot for the point sample, etc.

Demographic information

- Demographic sampling using the constant-effort mist netting methods of the Monitoring Avian Productivity and Survival (MAPS) program should be added in perpetuity to the Channel Islands landbird monitoring program. This methodology can provide information on population trends, productivity indices, and survival rate estimates, and it can be used to compare island populations to mainland MAPS stations.
- Adding a demographic sampling component to the existing landbird monitoring program is important for several reasons. First, demographic data can show "red flags" where density data may not. Changes in abundance reflect demographic processes, so the demographic data may be more sensitive to changes in certain rare and endemic species. Second, demographic data have explanatory power that abundance data do not. Demographic information can show whether changes in abundance are associated with increased mortality, or decreased fecundity, for example. Demographic information can give the managers an advantage in deciding what action to take in a relatively short time.
- The 1988 recommendation for productivity analyses of 3 indicator species should be replaced with a mist netting study for all birds in a local area. Island logistics and weather place logistical constraints on mist net sampling on the islands. A pilot project should be done to see whether a full MAPS station implementation is possible on the islands. Dr. Dave DeSante, The Institute for Bird Populations, estimates that it would cost about $20K to run six (6) MAPS stations (two stations on each of three islands) for one year on the Channel Islands. This level of effort would not provide extensive coverage of all islands, but it would provide enough information to assess demographic processes on the islands.

Institutional and programmatic considerations

- The Channel Islands data provide important information on the birds of the islands, and they should be published.
- There is a Congressional initiative to develop monitoring programs nationwide. The Channel Islands monitoring program should be used as a good example of long-term, institutionalized monitoring. The methods for program development, annual reporting, technical and management review, and program adjustment based on data review are good models for other parks.
- Channel Islands National Park should cultivate a long-term relationship with one or more landbird biologists who will guide the program, and use and publish the data in trend analyses, regional assessments, and integrated landscape analysis.

Summary

The Channel Islands landbird monitoring program is one of few nationwide with a consistent, long run of abundance data. The data should be further analyzed, interpreted for the scientific and management communities, and published. This program is especially valuable because it is nested within the larger Channel Islands Inventory and Monitoring Program that tracks many different components of island ecosystems. The entire Program is certainly worth supporting long-term, and it can serve as a good model for others.

The landbird monitoring protocol provides information on breeding and non-breeding bird abundance since 1993 on Santa Barbara, Anacapa, San Miguel and Santa Rosa Islands. Bird observations are collected annually along transects and at point count stations. Samples were not located at random or with respect to vegetation samples; rather they occur along and close to trails. The landbird protocol calls for periodic extensive sampling of a larger set of points located

by random methods across islands, for adjustment of the annual data. This periodic sampling was not done because of inadequate funding and labor. Consequently the data collected by the program only show trends in birds near the sample areas. The data cannot be used for habitat-by-habitat analyses or to infer trends island-wide.

Funding constraints also prevented productivity sampling of a suite of guild indicator species. Therefore the program does not provide demographic information that could be used to identify mechanisms associated with change in density over time. Hindsight shows that original funding commitments need to be carried through if the monitoring program is to succeed relative to its designed intent.

Recent developments in sampling methodology and integrated database management can be used to strengthen the Channel Islands landbird program. A new sample design should be implemented, but not until at least 3 years of simultaneous sampling under both the old and new protocols have been completed. Simultaneous sampling during the transition period will increase the short-term costs of the program, but it is essential for adjusting the old data for use in trend analyses. The new sample design uses variable circular plot point counts located by random methods across habitats on each of the 5 Park islands. The samples will be co-located with vegetation monitoring transects. Bird species' density estimates will be adjusted using detectability functions. Demographic data should be collected using constant effort mist-netting methods of the Monitoring Avian Productivity and Survival (MAPS) program. Density and demography data should be collected annually. The new program will be designed so that the abundance monitoring component requires about the same effort as the current program. Demographic monitoring will require additional effort. The new landbird monitoring protocol will be written after consultation with the vegetation monitoring program review team in September, 2000

Disadvantages of the current landbird monitoring program are that samples are inadequate to provide information about trends in abundance by habitat, or even island-wide. There is no way to link observed change to other ecosystem components or demographic processes, so the program cannot provide good information to managers on possible reasons for trends. The new sample design will provide spatial and temporal data on bird abundance, and it will provide information on demography that can be used to estimate and predict trends in landbird numbers and welfare.