https://irma.nps.gov/DataStore/Reference/Profile/2307769

Northern Spotted Owl Monitoring for the San Francisco Bay Area Inventory and Monitoring Network: 1997-2024 – Data Release Report

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Abstract

The northern spotted owl (NSO) has been listed as a federally threatened species since 1990, and the National Park Service (NPS) and partners began regular long-term monitoring in 1999 after conducting inventories in 1997 and 1998. Northern spotted owls inhabit forested regions from southern British Columbia through Washington, Oregon, and northwestern California, where Marin County is the southern limit of their range. NSOs face a variety of threats in Marin County including loss of habitat due to development and catastrophic fire, displacement by barred owls (Strix varia), change in habitat due to Sudden Oak Death, human disturbances during the breeding season, and mortality due to West Nile Virus. Although NSOs are typically found in old growth forests, in Marin County they reside in second growth Douglas-fir (Pseudotsuga menziesii), coast redwood (Sequoia sempervirens), bishop pine (Pinus muricata), mixed conifer-hardwood, mixed evergreen hardwood forests, as well as remnant old-growth stands of coast redwood and Douglas-fir. The primary food source for the NSO is the dusky-footed woodrat (Neotoma fuscipes). The Marin County population of spotted owls is of interest because of its isolation from other populations, high density and fecundity, and because they have been minimally impacted by barred owl range expansion. The goals of the northern spotted owl NPS San Francisco Bay Area Network (SFAN) monitoring program are to estimate trends in spotted owl occupancy and fecundity within the NPS legislative boundaries in Marin County.

Dataset SFAN_SPOW_EventSurvey contains 43 columns and 13068 observations. The SFAN_SPOW_AnnualBreedingStatus dataset contains 58 columns, and 2176 observations. Dataset SFAN_SPOW_NestTreeSurvey contains 72 columns, and 781 observations. Lastly dataset SFAN_SPOW_SpeciesDetection contains 46 columns and 17884 observations with 10 unique species.

Acknowledgements

Thank you to Alexa Ron for developing the initial NSO DRR template being using for this DRR.

Data Records

Data Inputs

Northern Spotted Owl inventories were first conducted by NPS and partners in 1997 and 1998 and regular long-term monitoring began in 1999. Original monitoring data are housed in a Microsoft Access database managed by the SFAN. A copy of this database can be found on the NPS DataStore at https://irma.nps.gov/DataStore/Reference/Profile/2307904 (SFAN 2025).

Summary of Datasets Created

This DRR describes the data package *Northern Spotted Owl Monitoring for the San Francisco Bay Area Inventory and Monitoring Network: 1997 - 2024 – Data Package* which contains a metadata file and 4 data files. These data were compiled and processed for dissemination by the SFAN and are available at https://doi.org/10.57830/2307768 (see Table 1).

Table 1. Northern Spotted Owl Monitoring for the San Francisco Bay Area Inventory and Monitoring Network: 1997 - 2024 – Data Package: List of data files.

File Name	Description
SFAN_SPOW_AnnualBreedingStatus.csv	Owl site survey results from 1997 to 2024
SFAN_SPOW_EventSurvey.csv	Summary of owl survey events from 1998-06-30 to 2024-07-24.
SFAN_SPOW_NestTreeSurvey.csv	Nest tree and habitat data from 1997 to 2024.
SFAN_SPOW_SpeciesDetection.csv	Records of Northern Spotted Owl and other owl detections from 1998-06-30 to 2024-07-17.

Data Quality Evaluation

Within the context of an annual data lifecycle workflow, data are reviewed and validated through data verification and validation procedures implemented by the San Francisco Bay Area Inventory & Monitoring Network (SFAN). After surveys are completed, monitoring personnel perform data entry validation to confirm entered data matches what was recorded on original data forms. Fields are checked for accuracy and completeness, including correct site names, expected locations and standard date and time entries. Data are checked against field notes when appropriate. After data entry verification has been completed records are given a data processing level of 'Provisional'.

Data Validation

Subsequent annual workflow steps are taken to perform formal and informal data validation quality control checks. Formal Data Validation procedures were performed on monitoring data through 2020, these validation checks are defined in appendix A. Records identified in the data validation routines were reviewed and corrected. Notes on any data validation steps taken outside of normal corrections are added to the respective narrative notes fields.

Post 2020 the SPOW database was overhauled into a new schema with an accompanying new data entry front end. In the post 2020 schema, quality assurance constraints were added to the database and data entry front end, reducing the need for the post hoc formal data validation routines in appendix A.

Additional Quality Control Checks

An annual Nest Tree Survey is completed for each monitoring site and summarizes the monitoring season results. During data review, each status field is examined against supporting evidence, including checking the related survey observations against the status and count fields.

Spatial data are reviewed for accuracy once data collection is complete. After being checked for completeness, UTM Easting and UTM Northing coordinates are uploaded to a map using GIS and examined for accuracy. Points are also compared to a map of points from the previous year where activity site center locations and site names are compared, and outliers within each activity site are identified.

Data Quality Flagging

Data quality control (QC) flagging fields were added to the back-end schema in 2023. Flagging fields allow for formal designation via data flag codes and can be used when records have non-normal monitoring conditions (e.g. failed QC checks, adverse weather, pandemic, etc.). The data quality flags that have been realized through field season 2024 are defined in table 1.

In the datasets, the data QC flagging fields are denoted by inclusion of a 'QCFlag' value in the column name. QC flagging fields represent whole monitoring components or can be further broken down into finer scale sub monitoring components (e.g. Tree Survey, Tree Measurements, Habitat, etc.). QC Notes fields accompany each QC flagging field and are similarly denoted by the inclusion of a 'QCNotes' value in a column name. This is where notes are added to define the QC error and when applicable, notes on the data correction that was performed. The QC flagging fields and QC Notes fields by dataset and related monitoring components are defined in table 2.

Blank values in QC flagging fields denote that no QC flag has been applied to the record. Data that has completed data validation are given a data processing level of 'Accepted'.

Table 2. Realized data quality control flags.

Flag Code	Flag Definition	Analysis Interpretation
ODEC	Original data entry value changed during quality control review	Record can be used in analysis
OSLC	Original site location was changed during quality control review	Record can be used in analysis

Table 3. Dataset quality control flag fields and monitoring component.

Abbreviated File Name [a]	Flag Field Name	Flag Notes Field	Monitoring Component
AnnualBreedingStatus	QCFlag	QCNotes	Annual site breeding status summary
EventSurvey	QCFlag	QCNotes	Event Survey site, place, where, when metadata
NestTreeSurvey	NestTreeSurveyQCFlag	NestTreeSurveyQCNotes	Nest tree survey
NestTreeSurvey	NestTreeQCFlag	NestTreeQCNotes	Nest tree reference location/geospatial information
NestTreeSurvey	HabitatFeaturesQCFlag	HabitatFeaturesQCFlagNotes	Habitat features associated with nest tree
NestTreeSurvey	NestTreeFeaturesQCFlag	NestTreeFeaturesQCFlagNotes	Nest tree measurements
SpeciesDetection	SpeciesDetectionQCFlag	SpeciesDetectionQCNotes	Species detections

Note: [a] The 'SFAN_SPOW_' prefix and '.csv' suffix have been omitted from file names for brevity.

The data within the data records listed above have been reviewed by staff in the NPS Inventory and Monitoring Division to ensure accuracy, completeness, and consistency with documented data quality standards, as well as for usability and reproducibility. This data package meets data quality standards and the *Northern Spotted Owl Monitoring for the San Francisco Bay Area Inventory and Monitoring Network: 1997 - 2024 – Data Package* is suitable for its intended use as of the date of processing (2025-1-29).

Usage Notes

The Northern Spotted Owl is a species that has been formally designated as threatened by the US Fish and Wildlife Service. Due to this designation, this data package is not available for download by the public. To apply for access to this data, please contact San Francisco Bay Area Network Data Scientist Kirk Sherrill (kirk_sherrill@nps.gov) or Point Reyes Biologist Taylor Ellis (taylor_ellis@nps.gov). Access will be granted to those who have legal statute to use the legally protected Northern Spotted Owl data. Users of the Northern Spotted Owl data are required to protect the data from dissemination to unauthorized users.

Users of the data package described in this report will find that some fields names follow Simple Darwin Core guidelines (Darwin Core Task Group 2014), but that most of the columns retain the name as it is found in the original raw data.

Acquiring the Data Package

This data package is available for download from the NPS DataStore at https://doi.org/10.57830/2307768 and can be directly imported into R data frames using the NPSutils package (Baker et al. 2023) and the following code:

```
devtools::install_github('nationalparkservice/NPSutils')
NPSutils::get_data_packages(2307768)
dat <- NPSutils::load_data_package(2307768)
list2env(dat, envir = .GlobalEnv)
```

Methods

Data Collection and Sample Processing Methods

All long-term monitoring surveys (1999–2005 and 2007–2017) for occupancy and reproductive information follow the "Modified Protocol for Spotted Owl Monitoring and Demographic Studies in Marin County California" (Marin Modified Protocol; Fehring et al. 2001) developed for use in areas with high potential owl/human interaction (Fehring et al. 2001, Press et al. 2010). The Marin Modified Protocol is modeled directly from the widely used "Spotted Owl Monitoring Protocols for Demographic Studies" (Forsman 1995) and the "Protocol for Surveying Proposed Management Activities that may Impact Northern Spotted Owls" (USFWS 2011). Survey methods include visual surveys of previous activity centers and nest sites, playback calling and hooting both during the day and at night, mousing (feeding live mice [Mus domesticus] to owls), visual nest checks, and counts of fledged young. Sites are visited until their occupancy and reproductive status have been determined according to the protocol's standards, including a minimum of three visits to sites where owls are not detected.

Standard spotted owl survey protocols may lead to changes in owl behavior due to repeated calling and feeding known as "mousing". Owls habituated to people may be more vulnerable to disturbance and manipulation by park operations and visitors. The Marin

Modified Protocol was developed collaboratively between the NPS and Point Blue Conservation Science to reduce the number of mice used to obtain the relevant nest site and reproductive information (Fehring et al. 2001, Press et al. 2010). The ease of access to nest sites and high visibility of nesting structures in Marin County facilitate intensive nest checks and often obviate the need to use mice to monitor reproductive status. Consequently, we rely on increased search time, more frequent visits, and owl behavioral observations to gather the data.

Spotted owls are sexed based on vocalizations and aged by tail feather shape and coloring (Forsman 1983). Barred owl detections are noted, and reports of barred owls in or around the study area are investigated, but there are no specific methods utilized for monitoring barred owls in our study. An annual breeding status is assigned to the individual spotted owl territories monitored and is determined using criteria in the Marin Modified Protocol.

All owl activity centers (either nest location or major roost site) are recorded in Universal Transverse Mercator (UTM) coordinates using a Global Positioning System (GPS) unit. Roost sites or nest trees for which GPS satellite access is not available are mapped on topographic maps from compass bearings taken in the field and GPS coordinates are obtained using GIS. Each year, at every known nest location, nest tree parameters are measured and surrounding habitat is described using standardized methods found in the monitoring protocol (Press et al. 2010).

This methods summary comes from "Monitoring northern spotted owls on federal lands in Marin County, California: 2018 report." (Ellis 2020)

Further details relating to data collection methods can be found in "San Francisco Bay Area Network Northern Spotted Owl Monitoring Protocol: Version 6.4." (Press et al. 2010)

Data Processing

Details pertaining to the data processing and quality control cleanup process are defined below.

- Data were read into R directly from a Microsoft Access database.
- Local times were converted to UTC and dates were formatted in accordance with ISO 8601.
- Where appropriate, Darwin Core fields were appended to fit the Simple Darwin Core Guidelines (Darwin Core Task Group 2014) and to add context to the source data.
- Verbatim taxonomy was checked against the Integrated Taxonomic Information System (ITIS) and accepted scientific names were included in the AcceptedScientificName field.
- Verbatim UTM coordinates were converted to decimal degrees.
- Typos were corrected and trailing white spaces were removed.

Metadata Processing

Metadata in the data package is in Ecological Metadata Language (EML) and was produced using the NPSdataverse https://github.com/nationalparkservice/NPSdataverse version 0.1.0. Packages in the NPSdataverse that where used for preprocessing and metadata creation include: EMLAssemblyline , EML, EMLeditor and QCKit.

The files SFAN_SPOW_AnnualBreedingStatus.csv, SFAN_SPOW_NestTreeSurvey.csv and SFAN_SPOW_SpeciesDetection.csv contain entirely blank QC columns. In order to produce valid EML metadata, versions of these files with a flag code in each of the empty QC flag columns were used to run the EML script. The flag codes were chosen as the placeholder value because they are possible categorical values for these columns. The files included in the data package do not contain these placeholder values but instead retain the entirely empty QC flag columns as they exist in the original database.

Data and metadata were run through quality control functions using the NPSdataverse packages EML, EMLeditor and DPchecker prior to data package publication. Quality control checks were focused on ensuring XML output is in valid EML standard data schema. Additionally, data congruence checks were done to ensure agreement between the datasets and the XML metadata file for the datasets.

Code Availability

The script created and used for the processing of this data can be found on the NPS DataStore at https://github.com/NPS-SFAN/SPOW_Datapackage. Due to the sensitive nature of Northern Spotted Owl data, this script is currently not available for download by the public. Access to the script can be requested in the steps described in the Usage Notes section of this report.

References

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Press, D., D. Adams, H. Jensen, K. Fehring, W. W. Merkle, M. Koenen, and L. A. Stacevich. 2010. San Francisco Bay Area Network Northern Spotted Owl Monitoring Protocol: Version 6.4. National Park Service, Fort Collins, Colorado;
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Appendix A. Data quality validation checks used in annual workflow through field season 2020.

ERRORCHECK37viewofnest: This query generates a list of records for which the recorder stated that there was an adequate view into the nest to see all owls that were present within it, but for which no young were recorded, no female was stated to have been on the nest, and the record does not indicate that the site is non-reproducing or a confirmed nest failure.

ERRORCHECK0referencebands: This query generates a list of all the band colors of owls banded in the study area. The list may be printed and used for reference in other error-checking queries.

ERRORCHECK40nonspowbands: This query generates a list of all non-NSO detections for which a band color was recorded. This list is used to check to see if this unusual event actually happened.

ERRORCHECK41nullbandvalues: This query will generate a list of all NSO detections for which no information was recorded for band colors. All records in this list are reviewed to assure that the appropriate value is "UNKNOWN" or is changed accordingly.

ERRORCHECK42owlsthatmoved: This query will generate a list of all NSO band combinations which were given (banded) at one location and then recorded as observed at another location. Narratives and other records are checked to verify, appropriate changes are made and then the remaining verified relocated owl records are printed up and used for reference during the next queries.

ERRORCHECK43ifybands: This query generates a list of questionable band colors. Records are reviewed to make sure that these represent owls that moved or for which there was a justifiably unknown "Band leg" value recorded. Partial colors are changed, e.g., "green" for "green white triangle" to "PRESENT." Only true values of band colors should be entered in the band color field. This query runs in conjunction to the ERRORjoinerBcolors and ERRORjoinerBdetecombos queries.

ERRORCHECK44ifyband+tabs: This query will generate a list of sex/band/tab/leg combinations that were recorded for detections which do not exist in the banding records. Some records should include the owls that have removed their tabs. All records are checked to verify accuracy and appropriate changes are made if possible. This query works with the ERRORjoinerBcombos query and the ERRORjoinerBdetecombos2 query.

ERRORCHECK45bandedleg: This query generates a list of all records for which the recorder stated that there were no bands on the owl (NONE as color) but for which they recorded a leg. Because "NONE" is meant to indicate that there were no bands on either leg

of the owl, records in this list are reviewed and the band color is changed to “UNKNOWN” and the leg is changed to U if the narrative indicates that only one leg was seen. If the narrative indicates that both legs were seen, the leg field is changed to “N” to represent that neither leg bore a band.

ERRORCHECK45bandedleg2: This query generates a list of all records for which the recorder stated that the band color was UNKNOWN, but for which they specified a leg. Records are reviewed to see if this was meant to indicate that no colored band was seen on the other leg, but that this leg remained unknown.

ERRORCHECK45bandedleg3: This query generates a list of all records for which the recorder stated “PRESENT” as the band color and for which they indicated a leg. Records are reviewed to make sure that the narrative indicates that the band was known to be on that leg.

ERRORCHECK71statusNY: This query generates a list of all sites which were designated as Nested with Young (NY) produced, but for which there are no SEARCH records which have detections of branchers or fledglings.

ERRORCHECK72statusNF: This query generates a list of all sites which were designated as a Nest Failure (NF), but for which there are no associated SEARCH records with the NONNESTINGINDICATORS field. The field represents surveys in which mice were taken, but were not brought to the young. Records are reviewed to make sure that the nest failures listed in this query were confirmed by adequate follow-up visits to visible nests after initial nesting confirmation.

ERRORCHECK73statusN: This query generates a list of STATUS records which were not designated Nested with Young (NY), but for which there was a fledgling record. Records are reviewed and appropriate changes are made.

ERRORCHECKstatusNN+: This query generates a list of STATUS records with Non-Nesting (NN) or Unknown (UK) Nesting status codes, but for which there is a positive response in the SEARCH records to the NESTINGINDICATORS field.

To check the UTMs in the STATUS table for accuracy, the table is viewed as a GIS event theme in a new ArcMap project following the directions given in Section 4.2(b) for checking the accuracy of UTMs in the DETECTIONS table. The theme of the preceding year’s shapefile is added. Unique symbols are set for the two different layers to compare the locations and look for large movements or incorrect UTMs. All UTMs which emerged in unlikely or suspiciously far points are reviewed. Any UTMs that need correcting in the database are then corrected.