

NATURAL AND HISTORIC RESOURCES UNIT



**A MANUAL FOR THE LANBIRD MONITORING PROGRAM OF
STINAPA BONAIRE, NETHERLAND ANTILLES**

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INTRODUCTION

About 210 resident and migratory bird species are found on the island of Bonaire. More than half of these species are landbirds. Some of the landbirds are endemic subspecies. Despite its small area, Birdlife International designated five Important Bird Areas (IBAs) on Bonaire.

STINAPA Bonaire is responsible for managing the natural resources and national parks of the island. Data about bird population status and trends are needed to guide decisions and evaluate management actions. In this document we (1) present the objectives of a landbird monitoring program; (2) explain the rationale used for the selection of target species; and (3) provide information about survey design and count methodology.

This manual is a working tool for STINAPA employees and volunteers doing landbird surveys on Bonaire. The monitoring program is one step towards the conservation and management of birds and their habitats on the island. However, a cost-effective integration of research and monitoring is needed for informed management decisions and the evaluation of management actions. To this end, STINAPA Bonaire is working in partnership with national and international organizations, and is continuing with capacity building efforts for employees and volunteers from the island and abroad.

GENERAL OVERVIEW

- 1) The monitoring program covers the areas considered potential habitat for feeding, nesting, and roosting of the selected species of landbirds on Bonaire.
- 2) Surveys are conducted at least twice per year (February-March and September-October). About 10 days are needed per sampling period.
- 3) Morning counts start after sunrise and stop at 10:00 hours. Afternoon counts start at 16:00 hours and stop before sunset.
- 4) At least two observers are needed for the collection of count and supplementary data related to habitat, food, disturbance, and other factors that may affect species detection and abundance at sampling units (fixed on-road and off-road points).
- 5) Additional information are collected about uncommon observations, such as large flocks in roosting areas, nesting activity, the presence of predators, and any other observation that may be of interest for research, monitoring, and management purposes. The location of these observations is recorded using GPS units. Date, time, and additional comments are also recorded. When possible photos are taken to provide complete documentation for future reference and consultation as needed.
- 6) Weather conditions are recorded as part of standard data collection.

- 7) Just like any other activity conducted by STINAPA Bonaire, human safety is always considered a priority over the completion of survey activities.

GOAL AND OBJECTIVES

As mentioned before, STINAPA Bonaire is responsible for the conservation and management of the natural resources and national parks of the island. Accordingly, the goal of the monitoring program is to detect trends in bird populations. The detection of negative trends should promote the integration of research and monitoring to identify the factors behind the declines, guide management decisions, and evaluate the effect of management actions intended to maintain or enhance bird population numbers. The objectives of the monitoring program are the following:

- 1) Estimate the density (\hat{D} = number of individuals per unit area) of all target species in February-March (before yellow-shouldered parrot nesting) and September-October (after yellow shouldered parrot nesting).
- 2) Estimate population size (\hat{N} = number of individuals in survey region A) for all target species. The survey region covers about 17,000 hectares in northern, central, and southern Bonaire, including about 6,000 hectares inside the boundaries of WSNP.
- 3) Estimate rate of change (trend) within and between years (that is, $\hat{R}_t = \hat{D}_{t+1} / \hat{D}_t = \hat{N}_{t+1} / \hat{N}_t$). In a closed population (i.e., no immigration or emigration) rate of change in estimated density or abundance equals births minus deaths.
- 4) Estimate detection probability (\hat{P}) for all target species using a combination of standard and multiple-covariate distance sampling and count-removal method. Detection rarely equals 1 or remains constant across survey samples given the effect of survey and site specific covariates (e.g., observer, species, and habitat among many others).
- 5) Collect supplementary data about habitat, food, and disturbance at fixed on-road and off-road counting points.
- 6) Prepare density and abundance GIS maps to identify hot spots of target species on the island.
- 7) Educate and raise public awareness about the conservation and management of birds and their habitats on Bonaire.

TARGET SPECIES

It is not our intention to monitor all the landbird species of Bonaire. Seeking to maximize the cost-effectiveness and efficiency of the monitoring program, we selected landbird species with different ecologies and life history traits, but that may be representative of the conservation status of dry forests and shrublands on the island. For example, the survival and reproduction of frugivores depend

on rainfall and fruit abundance, and thus they may serve as indicators of habitat quality inside the national parks and unprotected areas affected by agriculture and development.

The main target species of this monitoring program are the Yellow-shouldered Parrot (*Amazona barbadensis rotschildii*) and Brown-throated Parakeet (*Aratinga pertinax xantogenia*). Both are frugivores and endemic subspecies of the island of Bonaire. The island holds a large percentage of the world population of yellow-shouldered parrots, which are listed as vulnerable in IUCN's red list.

Also included in the monitoring program are five species of pigeons (mainly fruit eaters) and doves (which eat fruits and grass seeds): Bare-eyed pigeon (*Columba corensis*), Scaly-naped Pigeon (*Patagioenas squamosa*), Eared Dove (*Zenaida auriculata*), Common ground-Dove (*Columbina passerina*) and White-tipped Dove, (*Leptotila verreauxi*).

Omnivore birds that inhabit Bonaire include the tropical mockingbird (*Mimus gilvus*) and the troupial (*Icterus icterus*). Both are widely distributed and abundant all over the island. The troupial was introduced in the 1970s and may be competing with native species such as the yellow oriole (*Icterus nigrularis*) and pearly-eyed thrasher (*Margarops fuscatus*). Troupials use the empty nests of other birds for nesting and prey on the eggs and nestlings of other landbirds. To start understanding their ecological interactions, these three species were also included in the monitoring program.

The target species are the following:

- 1) Yellow-shouldered parrot (*Amazonia barbadensis rotschildii*)
- 2) Brown-throated parakeet (*Aratinga pertinax xantogenia*)
- 3) Bare-eyed Pigeon (*Columba corensis*)
- 4) Scaly-naped pigeon (*Columba squamosa*)
- 5) Eared dove (*Zenaida auriculata*)
- 6) Common ground-dove (*Columbina passerina*)
- 7) White-tipped dove (*Leptotila verreauxi*)
- 8) Tropical mockingbird (*Mimus gilvus*)
- 9) Yellow oriole (*Icterus nigrularis*)
- 10) Troupial (*Icterus icterus*)
- 11) Pearly-eyed thrasher (*Margarops fuscatus bonairensis*)

SURVEY DESIGN AND COUNT METHODOLOGY

Randomization, replication, and stratification are important elements of survey sampling design. A 1-square kilometer grid (100 hectares) is used to establish 185 points (*k*) following a random-systematic design, which provides representative coverage of northern, central, and southern Bonaire (Appendices 1 and 2); 75 points are sampled in the northwest (WSNP, Brasil, Labra, Karpata,

Dos Pos, and Roi Sangu); 45 points are sampled in the center (Onima, Fontein, Bolivia, Seru Largu, Seru Grandi and surrounding areas); and 30 points are sampled in the south (Washikemba, Kralendijk, Flamingo Airport, Lima, Bakuna and surrounding areas).

Points are located along roads and off roads. When access to an off-road point was too difficult, another point is randomly selected ≤ 500 meters of the center of the original point. Points are separated by a minimum distance of 400 meters. Two-observers conducted the counts, with one observer recording the data and the observer measuring detection distances and angles.

To meet the basic assumptions of distance sampling (i.e., birds at point centers are always detected; distances are measured to initial location; and distances are measured without error) the observers remain side by side for 6 minutes, recording aural and visual detections per minute, and measuring distances from points to birds detected singly or the geometric center of clusters (2 or more birds). Rangefinders binoculars are used to measure exact distances; but when this is not possible, detection distances were grouped into 10 categories (0–15, 16–30, 31–45, 46–60, 61–90, 91–120, 121–180, 181–240, 241–340, and 341–440 meters). Flying birds are counted but not included in density estimates, unless their initial locations were determined during or immediately after the 6-minute count. Distance sampling and count-removal (time-of-first detection) are used for parameter estimation and modeling.

To estimate rate of change over time, the surveys are conducted before and after the reproduction of yellow-shouldered parrots. At this time parrots of different ages and sexes are available to be included in the surveys. Other data collected included: date, time of day, temperature, wind speed, relative humidity, distance to roads, land cover, threats, and food abundance (see Appendix 4).

Appendix 1. Three regions used to establish 6-minute counting points on Bonaire.



Appendix 2 . Random-systematic design for 185 counting points in northern, central, and southern Bonaire; 150 points were surveyed in March 2010.



Appendix 3. List of counting points and GPS coordinates

Point	Latitude	Longitude
BONA001	12.30429	-68.39464
BONA002	12.30512	-68.38538
BONA003	12.30353	-68.3754
BONA004	12.30233	-68.36627
BONA005	12.2958	-68.3652
BONA006	12.29519	-68.37492
BONA007	12.29533	-68.38507
BONA008	12.29555	-68.39487
BONA009	12.29508	-68.40427
BONA010	12.2851	-68.35551
BONA011	12.28537	-68.3653
BONA012	12.28565	-68.37488
BONA013	12.28552	-68.38467
BONA014	12.28571	-68.39536
BONA015	12.28524	-68.40513
BONA016	12.27491	-68.35498
BONA017	12.27494	-68.36512
BONA018	12.27498	-68.37442
BONA019	12.27508	-68.38474
BONA020	12.27537	-68.39473
BONA021	12.27552	-68.40557
BONA022	12.26517	-68.35491
BONA023	12.265	-68.36479
BONA024	12.26492	-68.37457
BONA025	12.26518	-68.38478
BONA026	12.26507	-68.39508
BONA027	12.26521	-68.4053
BONA028	12.25578	-68.36531
BONA029	12.25542	-68.37489
BONA030	12.25604	-68.38477
BONA031	12.25558	-68.39474
BONA032	12.25561	-68.40437
BONA033	12.25551	-68.41467
BONA034	12.24564	-68.36535
BONA035	12.24587	-68.37522
BONA036	12.24555	-68.38481
BONA037	12.24537	-68.39474
BONA037B	12.24792	-68.39776
BONA038	12.24527	-68.40517
BONA039	12.23534	-68.38529
BONA040	12.23485	-68.39479
BONA040B	12.23036	-68.39461
BONA041	12.2354	-68.4051
BONA041B	12.23525	-68.40072
BONA042	12.22573	-68.38486

BONA043	12.22578	-68.39501
BONA044	12.22739	-68.40453
BONA045	12.22546	-68.37625
BONA046	12.28997	-68.37563
BONA048	12.26738	-68.34672
BONA049	12.26369	-68.34698
BONA050	12.26255	-68.35057
BONA051	12.25922	-68.34919
BONA052	12.25681	-68.35202
BONA053	12.25302	-68.3518
BONA054	12.24973	-68.34972
BONA055	12.24359	-68.29778
BONA056	12.24004	-68.29864
BONA057	12.23863	-68.35781
BONA058	12.23856	-68.36163
BONA059	12.23956	-68.36559
BONA060	12.23883	-68.35406
BONA061	12.23982	-68.35044
BONA062	12.23862	-68.34687
BONA063	12.235	-68.34728
BONA064	12.2322	-68.34478
BONA065	12.231816	-68.337282
BONA066	12.22711525	-68.33770234
BONA067	12.22208459	-68.33760882
BONA068	12.21721329	-68.33752759
BONA069	12.22216534	-68.3427562
BONA070	12.22695642	-68.3426503
BONA071	12.22703693	-68.34747079
BONA072	12.22232573	-68.34787977
BONA073	12.22232625	-68.35261844
BONA074	12.22751656	-68.35261795
BONA075	12.23206792	-68.35261752
BONA076	12.23222801	-68.35751965
BONA077	12.2274371	-68.35760175
BONA078	12.23238799	-68.36234015
BONA079	12.22743735	-68.36250392
BONA080	12.22751731	-68.36773307
BONA081	12.21745279	-68.33243614
BONA082	12.222244	-68.33251683
BONA083	12.22727467	-68.3325159
BONA084	12.23198595	-68.33259687
BONA085	12.23677713	-68.33251452
BONA086	12.24220735	-68.33251395
BONA087	12.24747773	-68.33226807
BONA088	12.25218898	-68.33283934
BONA089	12.2571398	-68.33275696
BONA090	12.26209083	-68.33267467
BONA091	12.25234443	-68.32279396

BONA092	12.24742434 -68.32287797
BONA093	12.23704606 -68.3229612
BONA094	12.23118341 -68.32296241
BONA095	12.22682576 -68.3230443
BONA096	12.22151724 -68.32272142
BONA097	12.21644683 -68.32280355
BONA098	12.21644459 -68.31291414
BONA099	12.2219904 -68.31283181
BONA100	12.22729841 -68.31274947
BONA101	12.23205181 -68.31250507
BONA102	12.21169075 -68.31259093
BONA103	12.23680537 -68.31258489
BONA104	12.24187602 -68.31266457
BONA105	12.24734304 -68.31233871
BONA106	12.20701597 -68.3125919
BONA107	12.20257527 -68.30270265
BONA108	12.20725141 -68.30286448
BONA109	12.21248049 -68.30278215
BONA110	12.21731331 -68.3026998
BONA111	12.22214614 -68.30277948
BONA112	12.22697904 -68.30294014
BONA113	12.23244582 -68.30269511
BONA114	12.23735841 -68.30261191
BONA115	12.24219149 -68.30285354
BONA116	12.24234771 -68.2926373
BONA117	12.23695993 -68.29304486
BONA118	12.23141377 -68.29296578
BONA119	12.22650156 -68.2929674
BONA120	12.22158929 -68.29288779
BONA121	12.21691455 -68.29264581
BONA122	12.21144735 -68.29264711
BONA123	12.20624814 -68.29267265
BONA124	12.20148339 -68.29267413
BONA125	12.19679795 -68.29283803
BONA126	12.19171511 -68.29275827
BONA127	12.18774301 -68.2929215
BONA128	12.18726391 -68.2823583
BONA129	12.17733721 -68.28252448
BONA130	12.16748882 -68.28260949
BONA131	12.1975875 -68.2827608
BONA132	12.20680219 -68.28283856
BONA134	12.21680806 -68.28307872
BONA135	12.22649645 -68.28283156
BONA136	12.22649292 -68.27283705
BONA137	12.21712198 -68.27267843
BONA138	12.2074337 -68.27243854
BONA139	12.19718946 -68.27292993
BONA140	12.18726192 -68.27277085

BONA141	12.1769377	-68.27253102
BONA142	12.16788356	-68.27245221
BONA143	12.16112982	-68.27277335
BONA144	12.16184076	-68.25782663
BONA145	12.17700856	-68.25806341
BONA146	12.18741158	-68.25789628
BONA147	12.19741853	-68.2577294
BONA148	12.2112378	-68.25772249
BONA149	12.22251464	-68.25755499
BONA150	12.22211108	-68.24309162
BONA151	12.20757814	-68.24301812
BONA152	12.19209255	-68.24302576
BONA153	12.17716043	-68.2424645
BONA154	12.16238972	-68.24279678
BONA155	12.14704702	-68.24267686
BONA156	12.13187938	-68.24276576
BONA157	12.12695028	-68.23310162
BONA158	12.14219778	-68.23260635
BONA159	12.15736602	-68.23284142
BONA160	12.17190227	-68.2325922
BONA161	12.18675301	-68.23266486
BONA162	12.20184405	-68.23273862
BONA163	12.21717063	-68.23264883
BONA165	12.14152149	-68.25258965
BONA164	12.14201272	-68.2174716
BONA165	12.13637971	-68.22706075
BONA166	12.131848	-68.21796539
BONA167	12.18483186	-68.24506826
BONA168	12.16975213	-68.26497958
BONA169	12.15553122	-68.25101301
BONA170	12.14964173	-68.22721379
BONA171	12.16226671	-68.22281998
BONA172	12.17298785	-68.22281371
BONA173	12.18569462	-68.22256189
BONA174	12.20173588	-68.22230901
BONA175	12.21213742	-68.217914
BONA176	12.12704217	-68.20785398
BONA177	12.12603646	-68.25748457
BONA180	12.13628516	-68.26259804
BONA181	12.14724616	-68.26665542
BONA182	12.1558223	-68.26437732
BONA184	12.12675878	-68.27291666
BONA185	12.17004395	-68.25000984

Appendix 5. Checklist of equipment and materials needed for fieldwork.

- Binoculars*
- Range finder*
- Compass
- Digital camera
- GPS unit with survey points
- Kestrel weather tracker or similar
- Extra batteries for electronic devices
- Vehicle with enough fuel (1/2 tank minimum per session)
- Field notebook
- Field forms
- Bird identification guides, cards, pictures
- Pencil/pen (permanent ink) and extra ones
- Drinking water
- Hat
- Sunglasses
- Sunscreen lotion
- Insect repellent
- First aid kit
- Machete
- Gloves
- Adequate shoes and clothing

*Rangefinder binoculars (2 in 1) are recommended to facilitate observation and measurement of detection distances.