

Protected Areas Network



Standardized Protocol for the Environmental Monitoring of Terrestrial and Coastal Protected Areas

Republic of Palau
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Harry R. Fritz
Minister

REPUBLIC OF PALAU
OFFICE OF THE MINISTER
MINISTRY OF NATURAL RESOURCES, ENVIRONMENT & TOURISM
P.O. Box 100 Koror, Republic of Palau 96940

Telephone: (680) 767-5435/3125
Fax: (680) 767-3380
E-mail: mnret@palaugov.net

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"Standardized Protocol for the Environmental Monitoring of Terrestrial and Coastal Protected Areas"
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Pursuant to the Protected Areas Network Regulations adopted on April 11, 2007, the following Standardized Protocol for the Environmental Monitoring of Terrestrial and Coastal Protected Areas is adopted this:

8 day of January 2013

Minister Harry Fritz
Ministry of Natural Resources, Environment and Tourism
The Republic of Palau

Standardized Protocol for the Environmental Monitoring of Terrestrial Protected Areas Protected Areas Network ~ Republic of Palau

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Foreword

The Protected Areas Network Act of the Republic of Palau (RPPL No. 6-39) supports important global, national and local conservation initiatives by enabling state governments to access financial and technical resources in order to establish and maintain local terrestrial protected areas as a management tool for conserving and protecting important forest and wetland resources. Regular monitoring of biological, socioeconomic and fiscal parameters provides key information for prioritization of conservation strategies, effective managerial decision-making and measuring the degree of success of the Protected Areas Network (PAN). Under the guidance of the Ministry of Natural Resources, Environment and Tourism, protected areas that are officially recognized within the PAN framework are required to include environmental monitoring elements in their management plans per §3306(f) of the Protected Areas Network Act as codified in Title 24 PNC 34.6.2 Standardized Environmental Monitoring Protocols. The following protocol was developed by Belau National Museum in coordination with the Palau Forestry Office for endorsement by the Minister of Natural Resources, Environment and Tourism as guidance for monitoring terrestrial protected areas in the PAN program.

I. Introduction

A. Scope. This protocol contains official procedural guidance for the environmental biomonitoring of inland forests, wetlands, and coastal littoral zones including mangroves. The protocol provides ridge-to-reef linkage with the PAN Protocol for Monitoring Marine Protected Areas, whose primary focus is the monitoring of reef fish; corals and other benthic indicators; and seawater quality.

B. Terrestrial (Forest) Protected Areas. Inland forests and littoral mangrove forests are important natural resources for small island nations due to the valuable ecological services they provide including soil retention, water quality, shoreline protection and resilience to threats from climate change. Forests also provide food, medicine, lumber and other renewable resources; serve as ecotourism attractions and refuges for rare and beautiful wildlife; and speak to the traditions and spiritual needs of the nation. A global assessment of forest resources ranked Palau's moist tropical forests among the top 20 high-priority forests for conservation with regard to the objectives and goals of several signatory international conventions including the Convention on Biological Diversity, the Framework Convention on Climate Change and the RAMSAR Convention on Wetlands (Buchanan *et al.* 2011). The high priority of forest conservation in Palau is further emphasized in the Micronesia Challenge, which was introduced in 2006 to the Convention on Biological Diversity (CBD) by five jurisdictions of the Micronesia region and which called for a commitment to “effectively conserve” 20% of the region's forest resources by 2020, exceeding the CBD 2020 global target for forest protection (17%).

C. Monitoring for Terrestrial Protected Area Management. Effective management of a terrestrial protected area requires a constant flow of reliable and timely monitoring information for use by managers to assess the degree of progress of the protected area toward accomplishing the goals and objectives of the area's management plan and toward achieving the aforementioned targets of global and regional conservation initiatives. Adaptive managers use monitoring information to objectively evaluate ecological change

over time and to detect emerging threats before irreversible adverse impacts occur. This protocol contains guidance for planning, conducting and managing a biomonitoring program for terrestrial PAN sites including preparatory steps, monitoring procedures, reportage, statistical analysis, equipment needs and staffing options. The biomonitoring methods and biological indicators in the protocol are based on the results of field research conducted by Belau National Museum and Palau Forestry Office for the Palau Ecosystem-Based Management (EBM) initiative (2006-2011). The biomonitoring methods and indicators were deliberated and endorsed by the Micronesia Challenge Terrestrial Indicators Group at meetings held in Chuuk (2011) and Palau (2012).

II. Purpose of a Biomonitoring Protocol

An effective biomonitoring protocol provides protected area site managers with useful, timely information that reflects a clear understanding of the ecology of the protected site and its key biological indicators of ecological change in order to (a) detect meaningful ecological changes within a protected area, (b) document and interpret trends revealed by the monitoring data and (c) compare conditions inside and outside the protected area.

III. Preparatory Steps

A. Rationale. Rich biodiversity is a decisive factor for identifying a protected area. It is therefore necessary to form a rough assessment of the biodiversity of a site by estimating its species richness. Bird diversity is generally accepted as a reliable reflection of overall biodiversity, so an account of bird species richness is essential. Equally essential in a forest ecosystem is an estimate of the species richness of trees and other flora. The preliminary assessment outlined below is, essentially, a rapid habitat assessment (Ralph *et al.* 1991) that combines assessments of the two most important and widely-used indicators ~ birds and vegetation ~ to gain a “snapshot” of a site's overall biodiversity. A preliminary assessment is meant to rapidly estimate the relative species richness and identify measurable indicators and habitat types but *not necessarily* to compile an exhaustive inventory of biodiversity.

B. Preliminary Assessment (Inland Forest). A preliminary assessment for an inland forest site is conducted along a 1km to 2km transect route divided into waypoints spaced 50m to 200m apart with a minimum of 5 waypoints (Appendix A), or along a standard NRCS zig-zag transect route (Appendix B). The transect route may follow a secondary road, foot trail or other convenient route that can be easily traversed in two hours or less. The following data are collected at each waypoint:

- (a) GPS coordinates
- (b) Time of day and prevailing weather conditions
- (c) Presence (only) of dominant and/or abundant plant species within 20m
- (d) Presence (only) of every bird species seen or heard during a 15-minute interval
- (e) Field notes on other noteworthy species

C. Preliminary Assessment (Mangrove Forest). A preliminary assessment for a coastal mangrove forest site is conducted along a navigable channel or other convenient route that can be easily traversed from landward perimeter to seaward perimeter in two hours or less. The following data are collected along the route:

- (a) GPS coordinates of start point, midpoint and endpoint
- (b) Time of day and prevailing weather conditions at start point and endpoint
- (c) Presence (only) of every bird species seen or heard along the route
- (d) Presence (only) of dominant and/or abundant plant species along the route
- (e) Field notes on other noteworthy species

D. Preliminary Assessment Thresholds. The results of a preliminary habitat assessment are used to decide if regular monitoring is warranted. Data from the National Program for Monitoring Forest and Coastal Birds (Olsen & Eberdong 2011, 2012) suggest that a threshold of ten or more bird species is necessary to warrant regular monitoring of bird diversity as a measurable indicator. Data from the Babeldaob Forest Survey (Costion 2011) suggest that a threshold of 30 plant species is necessary to warrant regular monitoring of plant diversity. Failure to detect a particular keystone or indicator species at a majority of waypoints during the preliminary habitat assessment is an indication that the species is not a reliable indicator species for that site OR that the species merits special attention in the site's management plan to increase its abundance.

IV. Monitoring Procedures

A. Measurable Indicators. The following indicators and monitoring methods are for use in a terrestrial protected area. Selection of appropriate indicators for a given site depends, in part, on the results of the site's preliminary assessment. For comparison purposes, outside reference sites are monitored by Belau National Museum and Palau Forestry Office at designated stations of the National Program for Monitoring Forest and Coastal Birds, using the same indicators and methods.

General Indicator	Measurable Indicator *	Methodology
Inland & mangrove flora	Vegetation profile	FIA (modified), or, NRCS zig-zag transect
Forest-dependent birds	Species richness <i>Keystone species</i>	Point count (15 min.) <i>Point count (08 min.)</i>
Coastal birds	Species richness Top predators	Area search (low tide)
Bats	Flying foxes	Point count (dusk)
Mangrove invertebrates	Sesarmid crabs	Quadrat counts (low tide)

* Appendix C

B. Biomonitoring Baselines. After the preliminary assessment, a minimum of two regular monitoring visits for vegetation profiles or six regular monitoring visits for faunal indicators are necessary to establish realistic baseline data sets for measurable indicators (see also Section VI - Informatics). After a suitable series of monitoring visits, the cumulative monitoring data should be reviewed and analyzed by site managers and PAN technical resource experts to determine if the data support reliable baseline levels for each appropriate measurable indicator or if additional visits are needed to arrive at realistic baseline levels for some or all of the measurable indicators. Once the baselines

have been established, the results of continued regular monitoring can be compared to the baselines in order to detect ecosystem change, using an outside reference station for additional perspective on conditions outside the protected area.

C. Method for Monitoring Inland and Mangrove Flora. Use the USDA Forest Inventory Assessment (FIA) procedures (USDA 2005) OR the NRCS zig-zag transect procedure from the preliminary habitat assessment (Section III) for annual monitoring of inland and mangrove flora. The Micronesia Challenge Terrestrial Indicators Group recognized the need to modify FIA procedures to adapt to local conditions. Consult PAN technical resource experts for recommendations concerning the modifications.

D. Method for Monitoring Forest-Dependent Birds (Appendix D). Conduct a monthly point-count at a permanent station selected from the waypoints of a site's preliminary assessment transect route for its relatively high species richness. A 15-minute point count for species richness and 8-minute point count of numbers of each indicator species are conducted simultaneously. The keystone indicator species are: Palau Fruit-Dove, Palau Bush-Warbler and Micronesian Imperial-Pigeon. The method for forest-dependent birds is based on the method in use for the National Program for Monitoring Forest and Coastal Birds.

E. Method for Monitoring Coastal Birds (Appendix E). Conduct an area search of exposed tidal flats at low tide, from a vantage point located on the seaward edge of a mangrove stand or coastal strand, to document species richness and numbers of each top predator indicator species. Monitoring visits are monthly, timed to coincide with low tides in daylight. Mindful that inclement weather or variable tide schedules may occasionally preclude monitoring, at least eight monitoring visits per year are nonetheless expected. The top-predator indicator species are: Rufous Night-Heron, Pacific Reef-Heron and Little Pied Cormorant. Area searches for species richness and indicator species are conducted simultaneously. The method for coastal birds is based on the method for the National Program for Monitoring Forest and Coastal Birds.

F. Method for Monitoring Flying Foxes (Fruit Bats) (cf. Wiles & Engbring 1993; Utzurrum *et al.* 2003). Regular monitoring of flying foxes consists of monthly point counts from a location with a commanding view of the protected area site to count numbers of the flying foxes. Counts are made by scanning the horizon and intervening hillsides and valleys in clear weather from 30 minutes before sunset to 50 minutes after sunset. Numbers of flying foxes are recorded at ten minute intervals and tallied at the end of the count. The observer has the option to sort flying fox activities into the following mutually exclusive categories:

<u>FLYING FOX ACTIVITY CATEGORIES</u>	
Category	Definition
Distant	Seen outside the boundary of the protected area
Flyover	Seen passing directly over the protected area but not landing
Incoming	Seen flying into the protected area but not leaving
Outgoing	Seen flying out of the trees in the protected area and not returning
Remaining	Seen circling the protected area
Roosting	Seen roosting or feeding in trees in the protected area

G. Method for Monitoring Sesarmid Crabs (*cf.* Macintosh & Ashton 2002; Salgado Kent & McGuiness 2006). Regular monitoring of sesarmid crabs, a keystone functional group, consists of searching exposed seaward mud flats at low tide from stations located on the perimeter of the mangrove stand. One to three 0.5m quadrats are marked with translucent, nylon fishing line wrapped around thin wooden skewers inserted into the sediment. For multiple quadrats, position the quadrats 6m apart in an arc around the observer's station, with a clear view of the quadrats. After a ten-minute waiting period, count all active sesarmid crabs in the quadrats using binoculars. Record counts of multiple quadrats separately. Monitoring interval is annual, coinciding with the mangrove flora monitoring, or more frequently if deemed appropriate by site managers.

H. Monitoring Frequency. The monitoring protocol calls for monthly monitoring of indicators that respond rapidly to ecological change and annual monitoring of indicators that respond slowly.

General Indicator	Monitoring Frequency
Inland & mangrove flora	annual
Forest-dependent birds	monthly
Coastal birds	monthly
Bats	monthly
Mangrove sesarmid crabs	annual or more often

I. Reference Sites. It is important for a protected area monitoring program to have outside reference sites for comparison with data collected inside the protected area. One function of the National Program for Monitoring Forest and Coastal Birds is to monitor a series of permanent reference monitoring stations representing major inland forest habitat types. Monitoring data from these stations are available to PAN site managers for comparison purposes.

J. Field Notes. In addition to recording the results of monitoring measurable indicators, it is important to keep field notes of all other observations including but not limited to ecological disturbances, flowers or fruit on or beneath vegetation, non-avian vertebrate fauna seen or heard, animal behaviors, invasive species, damaged (injured) and dead native flora or fauna, evidence of poaching *etc.*

K. Other Indicators. Managers may determine that other bioindicators provide useful information. For example, the Ants in Leaf Litter Protocol (Agosti *et al.* 2000a) and Aquatic Macroinvertebrate Rapid Bioassessment Protocol (Benbow *et al.* 2004) contain standardized procedures that are suitable for monitoring protected areas in Palau. Consult PAN technical resource experts for information concerning these and other supplemental monitoring methods and procedures.

V. Capacity Needs

- Two persons proficient in identifying the flora and fauna of the site
 - Estimated 150 to 200 person-hours per year
- One boat driver (remote coastal sites only)
- Binoculars, spotting scope, tripod
- Camera for photo-documenting field observations

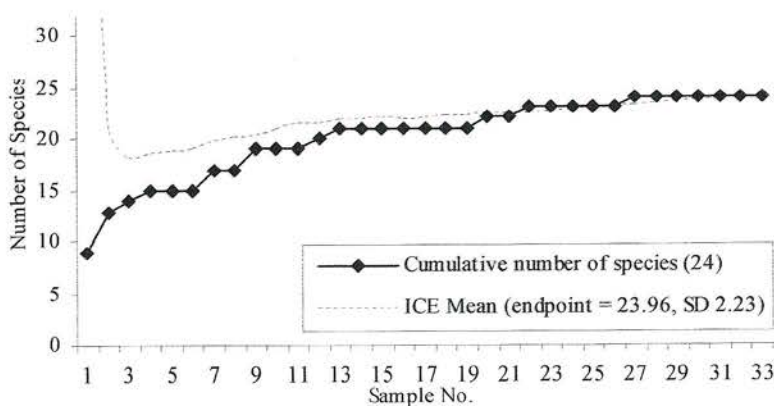
- GPS receiver (handheld)
- Digital thermometer for measuring ambient air temperature
- Stopwatch or timer
- Clipboards, pencils, field notebooks and other miscellaneous field supplies
- Ground and/or sea transportation to and from the site
- Fuel, salaries, refreshments and other routine recurrent expenditures

VI. Informatics

A. Data Processing. Field data must be collected in a uniform and consistent manner by the same person(s) each time, who must contemporaneously record the field data while on-site using standardized data sheets. The appendices provide examples of instructions for collecting data and standardized data sheets adapted from the National Program for Monitoring Forest and Coastal Birds for use in PAN protected areas. Further examples can be found in the USDA manuals listed in the reference section. Data should be entered into a database such as Access or into well-organized Excel spreadsheets as soon as possible. Completed original data sheets should be stored in a safe place for future reference and computer databases backed up at regular intervals.

B. Quality Assurance. Spreadsheets or other databases should employ standard cross-checking functions to assure the accuracy of the input process. Periodic physical audits of database entries may also be conducted by a disinterested party, comparing original data sheets to corresponding database entries at the 10% level. Occasional on-site field audits are at the discretion of local site management.

C. Statistical Analysis. This protocol is designed for statistical analysis using standard biodiversity estimators including the: Chao1 and Chao2 estimators, Incidence-based Coverage Estimator (ICE), Michaelis-Menten (M-M) estimator and Shannon Index. The following example of a species accumulation curve illustrates a typical statistical treatment of PAN monitoring data, using Excel[®] and EstimateS (Colwell 1997) software.



D. Data Management. A protected area's management plan should include directives governing the frequency, format and routing of periodic monitoring reports to assure an appropriate flow of data and feedback among stakeholders, the general public, the scientific community and other interested parties.

VII. Roles of Belau National Museum and Palau Forestry Office

PAN regulations require PAN sites to develop a management plan. An important component of the management plan is the monitoring plan. Belau National Museum and the Palau Forestry Office have a combined experience base of over 25 years in monitoring terrestrial and coastal sites throughout Palau. These institutions have the capacity to assist states in developing their terrestrial monitoring plans and, in many cases, to assist states with regular on-site monitoring of a particular PAN site.

Since most states at present do not have the capacity to conduct terrestrial monitoring, it is recommended that the states work with the Palau Forestry Office and Belau National Museum to (a) design and operate their monitoring programs and (b) if needful, to conduct regular terrestrial monitoring on behalf of the state by mutual agreement.

Since most states presently lack the informatics and computer capacities to conduct long-term data storage and processing, it is further recommended that the head of a site's monitoring team share copies of completed PAN data sheets with the Palau Forestry Office (flora) and Belau National Museum (fauna) for centralized archiving and analysis. These two institutions have the local capacity to store, compile and analyze monitoring data in order to provide timely reports, including statistical analyses, for the PAN site's management team as well as to merge PAN data into meta-databases such as PABITRA (Mueller-Dombois 2005), IUCN Red List (IUCN 2012) or Wetlands International (Delany & Scott 2006) in support of other national/international conservation initiatives.

VIII. Funding Mechanisms

Protected Areas Network Act §3306(f) charges the national government with the duty to provide technical assistance to state governments for management of their protected areas. For terrestrial protected areas, the chief local sources of technical assistance are Palau Forestry Office and Belau National Museum. Although funding for states is available through the regular PAN application process, separate continuing funding mechanisms are needed to provide support for these critical umbrella institutions.

Forestry Office. Federal funding earmarked for assisting states' PAN terrestrial (flora) monitoring programs and data management as outlined in this protocol.

Belau National Museum. Green fee funding for (a) assisting states' PAN terrestrial (fauna) monitoring programs as outlined in this protocol; (b) maintaining a network of outside reference stations under the National Program for Monitoring Forest and Coastal Birds, (c) providing technical support (d) curation of taxonomic reference specimens in the museum repository collections and herbarium and (e) archival acquisition, storage and retrieval of PAN reference materials by the museum research library, including materials listed in the Bibliography section below.

IX. Process for Revision of the Protocol

Mindful of the constant advancement of science, members of the PAN Technical Committee may, from time to time, recommend technical revisions of this protocol to the Ministry of Natural Resources, Environment and Tourism for consideration and approval.

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The following citations are a selection of helpful literature resources relating to the monitoring of the measurable indicators described in this protocol.

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Appendix A: Preliminary Habitat Assessment for Protected Areas Network (PAN) Terrestrial Sites

GENERAL INSTRUCTIONS:

1. Conduct concurrent plant and bird assessments at each of five to twenty waypoints evenly spaced 50m - 250m apart along a continuous on-site transect.
2. DO NOT conduct a count under any of the following conditions:
 - a. Rain
 - b. Fog
 - c. Excessive wind (Beaufort Number 4 or above)
 - d. Loud background noise (insects, machinery, traffic *etc.*)
 - e. High tide (coastal locations only)
3. Use a PAN Preliminary Biodiversity Assessment Data Sheet or facsimile to record plant species and birds that are heard or seen with the unaided eye. Confirm identifications with binoculars as necessary.
4. For common and scientific names of birds, refer to Wiles GJ. 2005. A Checklist of the Birds and Mammals of Micronesia. *Micronesica* 38(1): 141-189.

INSTRUCTIONS:

1. Use a separate Data Sheet for each waypoint
2. Enter the following in the appropriate spaces on the Data Sheet:
 - a. Date
 - b. Location
 - c. Waypoint No.
 - d. Waypoint GPS coordinates
 - e. Time
 - f. Temperature (° C)
 - g. Cloud Conditions (overcast, partly cloudy, scattered clouds, clear)
 - h. Wind Conditions (Beaufort Scale)
 - i. Tide (at coastal locations only)
2. Species Richness
 - a. Record the presence (only) and species of identified plants and birds (seen or heard) during a single 15-minute interval at each waypoint by entering the species name in the appropriate column of the Data Sheet.
 - b. Use a separate designation for each unidentified species (*e.g.*, Species A, Species B, Species C, *etc.*).
3. Record other noteworthy observations and comments as appropriate.
4. Enter the printed name and signature at the bottom of the Data Sheet.

PAN Preliminary Assessment Data Sheet

Date _____ Location _____ Waypoint No. _____
GPS: _____

Time
Temperature (°C)
Cloud Conditions
Wind (Beaufort Scale)
Tide (coastal locations only)

SPECIES RICHNESS — Enter the name or description of plant species that you see within 20m of this waypoint and each bird species that you see or hear at this waypoint.

[illegible]

TOTAL NO. SPECIES

Name (print) _____ Signature _____

Appendix B: Zig-Zag Transect Procedure

USDA Natural Resources Conservation Service

The following procedure are used to conduct a zig-zag transect. The preliminary assessment for forest birds (Appendix E) may be conducted simultaneously along the same transect route.

Step 1 – Select Main Stand

The main stand is usually made up of larger trees. There may be more than one general crown level. Beneath the main stand there is usually an understory of suppressed trees, advanced reproduction, or other plants. The principal concern should be with the main stand.

Step 2 – Choose a Route

Choose a route through the stand so you can sample a good cross section. Generally, this can best be accomplished by crossing the drainageways. On a sunny day you can use the sun as a direction marker by going toward it, away from it, or at some angle to or from it. A visible landmark can also be used as a direction marker.

Step 3 – Select a Starter Tree

The starter tree may be any tree that is a part of the main stand. No measurements are made of the starter tree. It serves only as a point of beginning.

Step 4 – Choose a Direction

At the base of the starter tree, face the chosen direction, place your heels together and position your toes to make a 90-degree angle. A line along the direction of travel bisects the angle formed by your feet (see Figure 636-2). A 90-degree arc is printed on some information sticks to help define the angle. When a 25" stick is held horizontally 12" from the eye, the ends of the stick form a 90-degree angle. A compass may also be used.

Step 5 – Locate Closest Tree

Locate the closest main stand tree, the center of which is within the 90-degree angle.

Step 6 – Determine Distance, Species, and Diameter

Pace or measure the distance from the center of the starter tree to the center of tree # 1. Determine the species of the tree identified in step 5 and measure its diameter at breast height (4.5 feet). Record measurements in the field notes (see Figure 636-5).

Step 7 – Rate Tree Condition

Examine the tree and rate its condition as good, fair, or poor. A good tree is reasonably straight, has a sound and full crown, does not have excessive limbs, and does not have evidence of scars, wounds, or disease. A poor tree may have a broken top, a bad crotch, excessive limbs, canker, wounds, scars, disease, or a combination of defects. Use fair as an intermediate rating. Do not confuse species desirability with the condition rating. Rate each tree on its merits, without regard to species.

Step 8 – Repeat Process

Standing at tree # 1, repeat steps 5-7 to select, measure, and rate tree # 2. Continue in this manner until at least 20 trees have been examined. The line of travel will proceed in a zigzag fashion.

PAN Zig-Zag Transect Field Notes Data Sheet

Tree No.	Species	Distance (feet)	Diameter (inches)	Condition	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
TOTALS					
AVERAGE					

Appendix C: List of Measurable Indicator (Keystone) Species

Common Name	Scientific Name	Palauan Name
Palau Fruit-Dove	<i>Ptilinopus pelewensis</i>	Biib
Palau Bush-Warbler	<i>Cettia annae</i>	Chesisebarsech
Micronesian Imperial-Pigeon	<i>Ducula oceanica</i>	Ieb
Rufous Night-Heron	<i>Nycticorax caledonicus</i>	Melabaob
Pacific Reef-Heron	<i>Egretta sacra</i>	Sechou
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	Deroech
Micronesian Flying Fox	<i>Pteropus mariannus</i>	Olik
Sesarmid crabs	Grapsidae: Sesarminae	Chebucheb

Indicator Species Gallery



Forest Birds, left to right: Palau Fruit-Dove, Palau Bush-Warbler, Micronesian Imperial-Pigeon



Coastal Birds, left to right: Rufous Night-Heron, Pacific Reef-Heron, Little Pied Cormorant



Sesarmid crabs



Micronesian Flying Fox

Appendix D: Monitoring Procedure for Forest-Dependent Birds at Protected Areas Network (PAN) Terrestrial Sites

GENERAL INSTRUCTIONS:

1. Conduct the monitoring between 0630 and 0730 hours.
2. DO NOT conduct monitoring under any of the following conditions:
 - a. Rain
 - b. Fog
 - c. Excessive wind (Beaufort Number 4 or above)
 - d. Loud background noise (insects, machinery, traffic *etc.*)
 - e. High tide (coastal locations only)
3. Use a PAN Bird-Monitoring Data Sheet or facsimile to record birds that are seen with the unaided eye or heard. Confirm identifications with binoculars as necessary

MONITORING PROCEDURE:

1. Weather Data - Enter the following in the appropriate spaces on the Data Sheet:
 - a. Time
 - b. Temperature (° C)
 - c. Cloud Conditions (overcast, partly cloudy, scattered clouds, clear)
 - d. Wind Conditions (Beaufort Scale)
 - e. Tide (at coastal locations only)
2. Indicator Species (eight-minute count)
 - a. Separately count all Indicator Species seen or heard during a single 8-minute interval.
 - b. Enter the final count for each Indicator Species in the appropriate space in the center column of the Data Sheet. If a species is not seen or heard during the eight minutes, enter zero.
3. Species Richness (15-minute tally of species)
 - a. Record the presence (only) and species identification of all bird species seen or heard during a single 15-minute interval by placing an "X" in the appropriate space in the center column of the Species Richness section of the Data Sheet.
 - b. Use the species list in the Data Sheet to record the presence of common species.
 - c. Use the spaces below the species list to record the presence and identity of species that are not listed above including all forest birds, coastal birds and unidentified species. Use the back of the Data Sheet if necessary.
 - d. Use a separate designation for each unidentified species (*e.g.*, Species A, Species B, Species C, *etc.*). Briefly describe each unidentified species in the Field Observations and Comments column of the Data Sheet
 - d. After 15 minutes, add the total number of species observed, including Indicator Species if present, and enter the total in the space provided near the bottom of the Data Sheet.
4. Record other noteworthy observations and comments as appropriate.
5. Enter the printed name and signature of the monitor at the bottom of the Data Sheet.

Date _____ Location _____

Temperature (°C)

Wind (Beaufort Scale)

Tide (coastal locations only)

[illegible]

Record the total number of species below

TOTAL NO. SPECIES (including Indicator spp.)

Name (print) _____ Signature _____

Appendix E: Monitoring Procedure for Coastal Birds at Protected Areas Network (PAN) Sites

GENERAL INSTRUCTIONS:

1. Conduct the monitoring at low tide (0.0 feet or lower) during daylight hours.
2. DO NOT conduct monitoring under any of the following conditions:
 - a. Rain
 - b. Fog
 - c. Excessive wind (Beaufort Number 4 or above)
 - d. Loud background noise (surf, insects, machinery, traffic *etc.*)
 - e. High tide
3. Use a PAN Coastal Bird-Monitoring Data Sheet or facsimile to record birds that are seen with the unaided eye, with binoculars and with a spotting scope

MONITORING PROCEDURE:

1. Weather Data - Enter the following in the appropriate spaces on the Data Sheet:
 - a. Time
 - b. Temperature (° C)
 - c. Cloud Conditions (overcast, partly cloudy, scattered clouds, clear)
 - d. Wind Conditions (Beaufort Scale)
 - e. Tide
2. Indicator Species
 - a. Separately count all Indicator Species seen at low tide (0.0 feet or lower) on exposed tidal flats, adjacent shoreline and lagoon channels.
 - b. Enter the final count for each Indicator Species in the appropriate space in the appropriate column of the Data Sheet. If a species is not seen or heard during the eight minutes, enter zero.
3. Species Richness
 - a. Record the presence (only) and species identification of all bird species seen or heard at low tide (0.0 feet or lower) on exposed tidal flats, adjacent shoreline and lagoon channels by placing an "X" in the appropriate space in the Species Richness section of the Data Sheet.
 - b. Use the species list in the Data Sheet to record the presence of common species.
 - c. Use the spaces below the species list to record the presence and identity of species that are not listed the species list. Use the back of the Data Sheet if necessary.
 - d. Use a separate designation for each unidentified species (*e.g.*, Species A, Species B, Species C, *etc.*). Briefly describe each unidentified species in the Field Observations and Comments column of the Data Sheet
4. Record other noteworthy observations and comments as appropriate.
5. Enter the printed name and signature of the monitor at the bottom of the Data Sheet.

PAN Data Sheet for Monitoring Coastal Birds

Date _____ Location _____

Start Time _____

Temperature (°C) _____

Cloud Conditions _____

Wind (Beaufort Scale) _____

Tide _____

INDICATOR SPECIES — <i>Enter the total number of each of the following three indicator species that you see at low tide.</i>		Field Observations
1. Rufous Night-Heron		
2. Pacific Reef-Heron		
3. Little Pied Cormorant		
SPECIES RICHNESS — <i>Place an "X" in the appropriate space for each species that you see at low tide.</i>		
RESIDENT SPECIES		Field Observations
Collared Kingfisher		
Crested Tern		
Black-naped Tern		
Black Noddy		
Brown Noddy		
MIGRATORY SPECIES		
Whimbrel		
Common Sandpiper		
Gray-tailed Tattler		
Ruddy Turnstone		
Pacific Golden Plover		

Record the total number of species below

TOTAL NO. SPECIES _____ (including Indicator spp.)

Name (print) _____ Signature _____

Appendix G: Socioeconomic Indicators

Indicators and Methods

Indicators are selected based on the assessment objectives and need to be identified by the assessment team. These indicators will form the basis for the creation of the questions that will be asked. The different methods for doing a socioeconomic study are described below:

- Secondary data are documents, reports, or any collected information that can be helpful in identifying gaps in existing knowledge in preparation for the assessment.
- Key informant interview involves experienced and/or knowledgeable individuals who can provide information for larger population such as a state. This semi-structured interview allows the interviewer(s) to deeply explore certain topics and allows the key informants to freely express and present the information that is needed.
- Focus group discussion is a type of a “semi-structured interview” resulting in qualitative data. This usually involves a selected group (4-10) of people who share a common background or knowledge. These discussions are based on a set of open-ended questions or discussion topics to generate qualitative information as well as to interact with each other to reach a consensus.
- Household survey is a questionnaire that has specific questions with the result of mostly quantitative data.

Data Collection and Entry Design

Based on the assessment objectives and the identified indicators, the assessment team will need to design questions for household surveys as well as questions and topics for key informant interviews and focus group discussions. These questions will need to be specific and straight forward in order to get a direct answer to the assessment objectives. Household data collection is a method that should be used at all times and depending on how much is known, key informant interviews and/or focus group discussions can also be used. These two types of methods are used to collect qualitative and more in-depth data and information. Once the questions are designed and pre-tested, the sampling approach should be determined. The sampling approach could either be random or non-random sampling.

The design of database is important because it will be used for storing data as well as for data analyses. Codes will need to be developed along with the database especially for the household data collection which can be done on an Excel spread sheet or SPSS or any other statistical analysis software. The analysis of the data will need to include the comparison of the quantitative data from the household surveys and/or focus group discussions.

Frequency of monitoring A socioeconomic study should occur every 3-5 years, unless there are drastic changes at the site that influence existing socioeconomic conditions. If such changes do occur, a socioeconomic assessment is required sooner than the recommended 3-5 years in order to capture the changes. Socioeconomic monitoring should occur every 3-5 years, unless there are drastic changes at the site that influence existing socioeconomic conditions and that require a socioeconomic assessment sooner than the recommended 3-5 years in order to capture the changes. Socioeconomic indicators are selected based on the assessment objectives and need to be identified by the

assessment team. These indicators will form the basis for the creation of the questions that will be asked. The following list of suggested indicators and methods to measure them is aligned with the socioeconomic indicators for the PAN protocol for monitoring marine protected areas.

Socioeconomic monitoring should occur every 3-5 years, unless there are drastic changes at the site that influence existing socioeconomic conditions and that require a socioeconomic assessment sooner than the recommended 3-5 years in order to capture the changes. Socioeconomic indicators are selected based on the assessment objectives and need to be identified by the assessment team. These indicators will form the basis for the creation of the questions that will be asked. The following list of suggested indicators and methods to measure them is aligned with the socioeconomic indicators for the PAN protocol for monitoring marine protected areas (MNRET 2012) .

General Indicators	Indicators	Suggested Methods
*Demographics	Number of people in household	Household survey
	Number of visitors	Key informants
	Age	Household survey
	Marital status	Household survey
	Occupation	Household survey
	Sources of household income	Household survey
Coastal & Inland Activities	Number of males and females who fish, hunt or harvest	Household survey
	Types of important plants, birds and invertebrates for household use, consumption, sale and cultural value	Household survey
	Average frequency of fishing hunting and harvesting by household members	Household survey
Threats/Opportunities	Perceived conditions of marine resources	Household survey Key informants
	Perceived threats/Opportunities to Terrestrial Protected Area	Household survey Key informants
	Perceived solutions to threats to Terrestrial Protected Area	Household survey Key informants
		Focus group discussion
Management	Benefits of Terrestrial Protected Area to household and community	Household survey Key informants Focus group discussion
	Awareness of rules and regulations	Household survey
	*Number of Terrestrial Protected Area supporters	Household survey
	Management effectiveness	Household survey Key informants Focus group discussion
	*Level of enforcement	Household survey Key informants

*These Micronesian Challenge (MC) indicators should always be included in the socioeconomic household questionnaires. These MC indicators were adopted during the 2nd MC measures workshop. When planning a monitoring program, different combinations of indicators in the table can be used depending on management objectives of the protected area, interests of stakeholders, cost and capacity.

