Recommended Survey Guidelines for the Mariana fruit bat

Introduction

The following guidelines are suggested for surveying the federally threatened Mariana fruit bat (*Pteropus mariannus mariannus*). The purpose of these surveys is to confirm the presence or absence of Mariana fruit bats and to estimate the number of fruit bats that may be impacted by a proposed project. Mariana fruit bats inhabit several forest types, (i.e., primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia*); therefore all forest types should be surveyed (Glass and Taisacan 1988; Wiles *et al*. 1989, 1995; Worthington *et al*. 2001; Wiles and Johnson 2004). This species can form colonies; however, solitary roosting by fruit bats is also common (Wiles 1987; Wiles *et al*. 1989; Worthington and Taisacan 1995). Therefore, fruit bat surveys must be implemented such that a single individual or multiple individuals within a colony are accurately counted (Utzurrum *et al*. 2003).

Three survey techniques are utilized to assess fruit bat activity and abundance: solitary counts, colony exit counts, and colony direct counts (Utzurrum *et al*. 2003). Solitary fruit bat counts are conducted to determine the presence or absence of fruit bats at a particular location (e.g. the proposed project site), as well as to evaluate flight paths, habitat use, and possibly reveal the location of a colony. Solitary fruit bat counts will be conducted at all project sites, unless the site is known to support a colony. If solitary fruit bat counts suggest a colony is present (i.e., more than five are present) or if a known colony is present, colony exit counts should be completed. Colony direct counts may be acceptable in place of colony exit counts as long as the direct count will not result in disturbance to the colony.

All types of surveys for Mariana fruit bats should be conducted by at least two observers per survey (to obtain an estimate of variance by observers), including a biologist who can identify Mariana fruit bats by sight, has experience carrying out all three survey techniques, and has extensive knowledge of suitable fruit bat roosting and foraging habitat. For all surveys, observers should use a spotting scope and binoculars. If available, night vision goggles should be used in low light conditions to facilitate observations. Survey methods below have been modified from Utzurrum *et al.* (2003).

Solitary Mariana Fruit Bat Counts

During solitary fruit bat counts, the proposed project site should be observed from multiple vantage points (stations), depending on the size and topography of the project site. Observation points should be located so that the entire project site can be evaluated for the presence or absence of fruit bats leaving from or returning to their roosts, along various flight paths. Multiple stations will be necessary if the size of the project area, topography, or other obstructions are present so that the entire area cannot be observed from one vantage point. Where possible, stations should be situated so the observer is looking up (e.g. toward a hill or ridgeline) and the survey area comprises a large amount of sky to facilitate silhouetting and better observation of fruit bats. Observers should be in place pre-dawn to take advantage of fruit bat movements in low light. Surveys begin

when there is sufficient pre-dawn light to visually detect flying animals and continue for approximately two hours after full light. Dusk surveys should be conducted from the same locations, starting two hours before sunset and continue until it is too dark to accurately detect species. To determine presence or absence of fruit bats, at least five sets of sunrise and sunset surveys should be performed over a period of at least one month. However, survey schedules will vary on occasions where implementation of the proposed project is time sensitive or where surveys are carried out on remote islands (e.g., Pagan, Aguiguan).

From each station, the designated count area should be continually scanned to search for movement of flying animals, with or without the use of binoculars depending on the distance between the observer and the area being viewed. When an animal in flight is observed, use binoculars or a spotting scope to identify whether it is a fruit bat or a bird. If it is a fruit bat, follow it until it flies from sight or roosts in the forest. If several fruit bats are using the area, it may be difficult to determine the number present. Judge whether each fruit bat is a new individual or whether it may be an individual observed earlier that has moved. If a fruit bat flies into a tree to roost and a fruit bat leaves from the same location, assume it is the same individual. If a fruit bat flies out from a different part of a large tree, it may be a different individual. When it is not obvious or you cannot tell if the individuals are different, assume it is a different fruit bat and annotate on the map and data sheet that it may be a "repeat." Solitary fruit bat surveys will provide an indication of fruit bat activity for a project area and these surveys are not designed to provide a precise count of the absolute number fruit bats within the project site. Therefore, we will estimate the number of fruit bats that may be affected by the proposed project based upon the number of "new" and "repeat" individuals detected.

Colony Exit Counts

Colony exit counts depend on having an unimpeded view of the route taken by fruit bats departing the roost site. Fruit bats may depart in one direction or several directions; the site needs to be evaluated prior to surveys for this to be determined. If several routes are being used, multiple observers may be necessary to do the count.

Fruit bats are counted as they pass a predetermined landmark that is clear to the observer. Animals that circle back should be noted so they are not counted twice. The time at which fruit bats depart their roosts can vary at each colony. Where there is active poaching, fruit bats may not depart until dusk or after dark. As with solitary fruit bat counts, if you cannot determine whether the individuals are different, assume it is a different individual and annotate on the map and data sheet that it may be a "repeat."

Colony Direct Counts

If roosting fruit bats can be observed from a distance, direct counts can be conducted during the day while individuals are sleeping; this should only be done if it will not result in a disturbance to the fruit bats. A spotting scope will permit the observer to examine dense vegetation more accurately than binoculars. Fruit bats will move into dense foliage as heat increases and heat haze can make using a spotting scope or binoculars difficult; therefore, it may be ideal that these counts are completed during the early morning prior

to 0900. However, late afternoon counts may also be carried out depending on the temperature and if fruit bats have taken refuge in the vegetation. Prior to conducting direct counts, the site should be assessed to determine what time of day is most favorable for counts. Additionally, cloudy days can be exceptional occasions to perform direct counts as fruit bats may not withdraw into the shade as quickly and the lack of direct sunlight permits easier counting of fruit bats. Colony direct counts provide an estimate of the number of individuals using the area, but these estimates can vary greatly depending on exposure of the colony and vegetation density.

Data Collection

All survey events should be recorded on field data sheets. At a minimum each observer should record the following information: observer name, location of site, location of observation point(s), survey type, bearing boundaries of the station count area, weather conditions (wind speed – using Beaufort wind scale, rain, cloud cover, moon phase), observation distance, start and end time, general habitat description (native, tangantangan, secondary forest, etc.), and number and location of "new" and "repeat" observations. Where possible, record the species of tree(s) used for roosting and foraging purposes. Surveys should not be conducted on days when weather conditions prevent adequate viewing of the site with binoculars or a spotting scope.

Mapping Mariana Fruit Bat locations

It is important that the survey area is adequately mapped and that approximate roosting locations and flight paths are mapped. We recommend the use of a Global Positioning System (GPS) and Geographic Information System (GIS) to facilitate this effort. A topographic map or other imagery map should depict the area at an appropriate scale and the observer should draw where the observer vantage points are located, including trees and other reference points. Multiple maps may be necessary to accurately depict the differing areas of a project site. Each fruit bat sighting should be noted on the map showing where it was first observed, flight direction, where it was lost from sight, and the time observed. Mark the location for each occasion an individual roosts, and flies into or out of the area.

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