Purple Martin Colony Population Size and Reproductive Success Evaluation Protocol, ver. 3.2 (5/10/06)

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At the fall annual meeting in 2002 the Western Purple Martin Working Group recognized a need to develop reliable and consistent standard methods for determination of both colony population and reproductive success, to facilitate comparison between sites and compilation into regional estimates. These follow from the initial development of colony and nest site use classification protocols and are beyond the scope of the Breeding Bird Atlas protocols, which are concerned solely with the probability of a species breeding in a given map area. An attempt is made to provide these methods here, based on the procedure that has been developed and used in BC since 1997 by Laura Darling, Cam Finlay and others, with additional input by Dan Airola re: his recent experience with bridge-nesting martin colonies in Sacramento, CA.

The BC productivity protocol was devised to consistently and systematically monitor abundance, reproductive success and productivity at accessible nest-box colony sites to allow comparison of results between years and thus tracking and adaptive management of the recovery program (see annual BC summary reports to WPMWG). The number of nesting pairs/active nests (1+ egg/nestling observed) determined from nest box inspections is used as a reliable index of abundance, necessarily excluding a small highly variable proportion of non-breeding birds. This number, a direct measure of reproductive effort, is the basis of all nesting success and productivity estimates. At inaccessible nest sites much of the necessary information to reliably determine abundance, nesting success and productivity will not be directly available by cavity inspection and must be estimated indirectly where possible.

COLONY POPULATION SIZE

Number of Confirmed (& Inferred) Nesting Pairs (= no. of active nests with 1+ eggs or nestlings):

- known underestimate of nesting colony population (excludes unpaired and non-breeding birds)
- most stable and reliable estimate of relative abundance, since non-breeding birds move between colonies
- could include numbers inferred by diagnostic nesting behavior criteria at inaccessible sites
- thus most repeatable and widely comparable measure of local abundance between sites, site types, years, etc.
- reliably estimates number of reproductive units (pairs) as basis for estimates of nesting success and productivity
- includes only known active nests to avoid biasing high by unused nests (false nest starts, pre-laying re-nesting)
- may be biased high by clutch abandonment and re-nesting (i.e. >1 active nest / pair), presumably uncommon.
- may be biased low by removal of eggs or nestlings from active nest (infanticide) by bachelor males seeking mates

REPRODUCTIVE SUCCESS

At ***accessible*** nest sites (e.g nest boxes) egg and nestling production and fledging success can often be monitored directly by inspection. At ***inaccessible*** nest sites (e.g. natural cavities in trees and snags or structures) data for egg and nestling numbers are usually unavailable and determination of number of young fledged requires extensive monitoring effort to accurately document fledging. Abundance (as no. of breeding pairs = no. of active nests) and nesting success (% of active nests with nestlings fledged or near fledging age) can often be assessed fairly reliably from observations of activity and behaviour, but accurately assessing productivity is more difficult and time-consuming and less reliable. In large inaccessible colonies, where sufficient observation of all nest sites may be difficult or impossible, some measures might be derived from a *monitored random sub-sample of the known active nests* and applied systematically to estimate overall nesting success and productivity. Obtaining a representative sample may be problematic.

The following six measures are used to assess nesting success and productivity at accessible nest sites in BC, based on inspection of all (or almost all) nest boxes on at least one occasion, often two or three, while banding nestlings. Measures in ***bold italic*** (only) may also be available at inaccessible sites.

Nest success rate (no. of successful nests / no. of active nests [1+ egg/nestling at inspected sites]):
- readily available from inspected sites, accuracy may be possible with frequent observation at inaccessible sites
- no. of confirmed/inferred active nests is assumed to approx. = no. of nesting pairs (most reliable estimate)
- best estimate of nesting success based on number of valid nesting attempts (= no. of nesting pairs)
- incorporates post-laying nest failures and re-nesting attempts
- ignores multiple incomplete or 'false' nesting attempts (eg some birds may build extra unused nests)
- may overlook occasional pre-laying nest failure or abandonment (see * below)
- a standard measure of reproductive success for PUMA (in BC) and with other bird species

Minimum no. of eggs produced (total eggs + nestlings observed):
- available from inspected sites only, NOT available at inaccessible sites
- base measure of total reproductive output, prior to egg & nestling mortality
- may be under-estimated from nestling counts due to undetected egg/early nestling mortality, variable nesting timing
- may be biased low by infanticide behaviour or bachelor SY males – emptied nests may be mistaken for nest starts

Mean no. of eggs/nesting pair (= /active nest; 1+ egg or nestling):
- available from inspected sites only, NOT available at inaccessible sites
- baseline comparative measure of reproductive output, prior to egg & nestling mortality
- may be under-estimated from nestling counts due to undetected egg/early nestling mortality, variable nesting timing

Number of young likely fledged (e.g. from nestling counts at banding time):
- available from inspected sites; accuracy may be possible with frequent observation at inaccessible sites
- measure of fledgling production after egg & nestling mortality
- may be slight over-estimate from nestling counts due to undetected late nestling mortality (varies with weather)

Mean no. of young fledged / nesting pair (= /active nest; 1+ egg or nestling):
- available from inspected sites, may be possible with frequent observation at inaccessible sites
- comparative measure of fledgling production after egg & nestling mortality
- may be slight over-estimate from nestling counts due to undetected late nestling mortality (varies with weather)

Egg survival rate (no. of young probably fledged / no. of eggs laid):
- available from inspected sites only, NOT available at inaccessible sites
- comparative measure of egg & nestling survival/mortality due to weather, nest predation, etc.
- may be slight over-estimate from nestling counts due to undetected late nestling mortality

* Most likely disruption that prevents egg laying (or causes nest abandonment before or during incubation) is aerial predation removing one member of a nesting pair. This reduces site population at least temporarily and may reduce no. of nesting pairs/nesting attempts (pre-egg laying) and no. of successful nests (depending on re-pairing and re-nesting). Another cause is nest predation, which may remove one or both adults and often causes nest or colony site abandonment. Predation losses likely occur fairly regularly at a low level, though some sites are probably more vulnerable to predation than others (esp. nest predation - 12" deep nest boxes with wire roof guard and metal pole guards provide protection from most nest predators – gulls, crows, owls, rats, raccoons, etc.) but predation events are rarely observed or documented.

The foregoing is intended to provide on overview of the procedures used for estimating local abundance, nesting success and productivity at inspected accessible nest sites in BC, as well as some initial comments on other procedures suggested for this purpose, as a first step towards developing a standardized protocol for producing these estimates. It is evident that reliably estimating production (no. of young fledged) and especially productivity (no. of young fledged per active nest or nesting pair) for comparison between sites and years is much more difficult at inaccessible sites, so we may require a 2-level protocol based on nest cavity accessibility for inspection. I welcome any further input and suggestions in this regard.

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