Standard Operating Procedure

SC24-06 PINNIPED MONITORING FOR ABUNDANCE AND BODY CONDITION (OCTOBER 2024)

Animal welfare is the responsibility of all personnel involved in the care and use of animals for scientific purposes.

Personnel involved in an Animal Ethics Committee approved project should read and understand their obligations under the *Australian code for the care and use of animals for scientific purposes*.

Version 1.0

October 2024

GOVERNMENT OF WESTERN AUSTRALIA

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Approved by the DBCA Animal Ethics Committee:

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Contents

1 Acknowledgements

This standard operating procedure was originally developed by Holly Raudino and Kelly Waples, with contributions from Toby Larke, Emma Rowe, Sam Lawrence, Eden Harris, Vaughn Chapple, Anthony Desmond, and Evan Hallein. Richard Campbell, Rebecca McIntosh, Dirk Holman, Jarrod Hodgson, Simon Goldsworthy, Chandra Salgado-Kent and Sylvia Parsons have generously shared their extensive knowledge of pinniped research, monitoring and handling.

2 Purpose

This Standard Operating Procedure (SOP) describes multiple methods used by the Department of Biodiversity, Conservation and Attractions (DBCA) for measuring pinniped abundance and body condition directly and via remote techniques (i.e. aerial survey) to investigate the status and condition or 'health' of pinniped populations within the Otariidae family (i.e. fur seal and sea lions). Measures of population size (abundance) and body condition, via morphometrics and investigation into some disease and health parameters, can be used to infer whether these populations are increasing, decreasing or stable and whether the individuals within those populations are healthy or compromised with nutritional stress, parasites, pathogens, or disease.

There are two main species of pinnipeds that reside and breed in Australia. These are the Australian sea lion (*Neophoca cinerea*) and the long-nosed fur seal (*Arctocephalus forsteri*). The Australian sea lion is listed as Endangered under Australian legislation (EPBC Act, Commonwealth and the Biodiversity Conservation Act, Western Australia). The long-nosed fur seal while specially protected is not considered threatened with extinction. One of the important considerations when studying these species is the difference in their breeding cycles. Long-nosed fur seals breed annually in summer (Campbell *et al*., 2014). Australian sea lions have a longer, asynchronous breeding cycle closer to 18 months long and this makes them potentially more challenging to study. Other pinnipeds that occasionally visit Australian waters and shores include other eared-seals (otariids) such as the sub-Antarctic fur seal (*Arctocephalus tropicalis*) and phocids (true seals) such as southern elephant seals (*Mirounga leonina*) and leopard seals (*Hydrurga leptonyx*). There are no established research or monitoring programs for these latter species in Western Australia. Standard techniques used to assess population parameters including health for the former species include direct counts at aggregation sites, use of aerial photography including via Remotely Piloted Aircraft (RPA) to count individuals and assess health status, mark-resight surveys and capture and handling to assess demographic and health parameters. This SOP outlines appropriate protocols for these field methods and provide detail on risk assessment and mitigation measures to prioritise human safety and animal welfare.

While the techniques are detailed within this document, it is not intended for inexperienced personnel to undertake these, unless under the direct supervision of those with appropriate experience, qualifications, and authorisations. Much of this information is derived from techniques that are commonly used for research on pinnipeds and is based on the experience of DBCA Marine Science Program, Regional and District staff, South Australian and Victorian Government colleagues and University collaborators.

3 Scope

This SOP has been written specifically for scientific and education purposes, and approved by the DBCA's Animal Ethics Committee (AEC). However, this SOP may also be appropriate for other situations.

This SOP applies to all fauna survey and monitoring activities involving the use of pinnipeds undertaken across Western Australia by DBCA (hereafter the department) personnel. It may also be used to guide fauna related activities undertaken by Natural Resource Management

groups, consultants, researchers and any other individuals or organisations. All department personnel involved in surveying, monitoring and handling pinnipeds should be familiar with the content of this document.

4 Animal Welfare Considerations

All research and monitoring activities that involve handling or disturbing wildlife must consider, address and plan for the range of welfare impacts that may be encountered. Strategies to reduce impacts should be identified during the planning stage to ensure that they can be readily implemented during surveys or animal captures/handling, and contingencies for managing welfare issues are in place. All personnel involved in the project should be aware of the range of issues that they may encounter, the options that are available for reducing impacts and improving animal welfare, and the process for managing adverse events.

Department projects involving on-ground direct counts, animal handling and RPA surveys will require approval from the department's AEC. Key animal welfare considerations that should be taken into account are listed below and highlighted throughout the document.

4.1 Injury and unexpected deaths

If adverse events including injury, unexpected deaths or unplanned requirement for euthanasia occur, then it is essential to consider the possible causes and take action to prevent further issues. Adhering to the guidance in this SOP will assist in minimising the likelihood of adverse events. For projects approved by the department's AEC, adverse events must be reported in writing to the AEC Executive Officer as soon as possible after the event by completing an *Adverse Event Form*. Guidance on first aid for animals and field euthanasia procedures are described in the department SOPs for *First Aid for Animals* and *Euthanasia of Animals Under Field Conditions*. Where infectious disease is suspected, refer to the department SOP for *Managing Disease Risk and Biosecurity in Wildlife Management* for further guidance.

4.2 Level of impact

Potential animal welfare impacts experienced during pinniped abundance and body condition monitoring surveys include:

- Pests and diseases can be introduced to breeding island colonies and haul-outs if staff to do not follow appropriate hygiene measures to ensure shoes, bags and equipment are clean.
- The presence of people within breeding colonies and in close proximity may cause a short-term behavioural response by pinnipeds that can lead to abandonment of pups or disturbed rest.
- The presence of people within breeding colonies and in close proximity may cause more severe behavioural response by pinnipeds such as older cohorts fleeing and unintentionally trampling and injuring or killing the younger and less mobile pups. Pinnipeds (all age classes) are also susceptible to injuries or falls from rocks and cliffs if cornered or pursued.
- The handling, sampling and marking of pinnipeds may cause stress or injury to the individual and potential for the introduction of disease or infection if protocols and

hygiene standards are not followed.

- When handling and sampling pinnipeds heat stress and hyperthermia should be considered, particularly of young pups that have not fully moulted and therefore can't use water to thermoregulate. Surveys should be timed for early in the day and pups should not be restrained, bagged or weighed in high ambient air temperatures.
- Flying an RPA over hauled out pinnipeds may cause stress or disruption of resting, potentially causing animals to flee to the water. There is also the potential to crash an RPA onto land, potentially hitting a pinniped and causing injury or disturbance.

If surveys are conducted quickly and quietly following the protocols outlined below, then the risk and overall impact should be minimal and short-term. Project planning must involve the identification and mitigation of all potential welfare risks to minimise their impacts as much as possible. Investigators must be aware that the effects of a series of stressors, such as capture, handling and marking can be cumulative.

5 Procedure Outline

Abundance is a metric commonly used to monitor population size and trends in population status over time. Abundance can be assessed through direct counting of individuals in a census type approach or through marking and resighting individuals and using mathematical models (mark-resight models) that account for individuals that may be missed during a direct count or census to estimate abundance. Some reasons that pinnipeds may be missed during a survey include that they may be hidden by vegetation or rocks and were not seen (Visibility bias) or that they were not present in the study area (island) at the time as they were at sea (availability bias). Mark-resight modelling and the resulting abundance estimate has the advantage of providing a measure of confidence in the estimate, usually presented as an upper and lower estimate known as confidence intervals around the best estimate.

To assess the abundance of pinnipeds, surveys are conducted on known breeding islands or haul out sites at times of peak aggregation. For Australian sea lions, the accepted method has been to count pups at the peak of the breeding season as they do not disperse prior to being fully moulted and can be counted in a direct census. A multiplier is used to get an index of population abundance. There are several techniques that may be used to count pups including on ground counts, aerial survey (via helicopter) and aerial survey using an RPA. As an alternative to pup counts, mark-recapture modelling may be undertaken where marks are applied to a number of animals (of various age cohorts) over a short period of time and several repeat surveys are undertaken to count marked individuals.

The decision of which technique to use will depend on the accessibility of the site i.e. whether safe landing of personnel on the island in weather conditions (wind/swell) can be achieved. The terrain of the island will also determine which techniques is chosen, if there are many caves and overhangs (that can be typical of granite islands on the south coast) or thick vegetation (typical of colonies on the west coast) then ground counts may be necessary to detect pups.

During surveys all age and sex classes on land are counted (bull, sub-adult male, cows, juveniles, pups (classified according to their pelage/cost colour black, brown, moulted or

dead)). This provides an indication of timing in the breeding season e.g. if cows are being mate guarded and black pups are present then it is early in the breeding season, later in the breeding season pups will be brown or fully moulted. It also provided a better understanding of the population demographics and patterns of use by various age cohorts of each breeding island or haul out site.

5.1 On-ground direct count surveys

5.1.1 Season/ Timing

Pup numbers are chosen as the index of abundance because pups are easily recognisable relative to other age classes, are mostly present at one time in the breeding colony unlike other age classes where this varies, and they remain in the colony until fully moulted and therefore will not usually take to the water during counting (Shaughnessy *et al*., 2011). Thus some knowledge of when and where to expect breeding aggregations is critical to monitoring pup abundance. Breeding sites and islands for both Australian sea lions and long-nosed fur seals are well documented, though new sites do emerge over time.

Timing of the beginning of a breeding season is different for long-nosed fur seals and sea lions. Australian sea lions breed around every 17.5 months asynchronously between islands. Thus the breeding season can be calculated by adding 17.5 months to the beginning of the previous season if known (Shaughnessy *et al*., 2013). Due to the sea lions' asynchronous breeding between islands, survey dates will vary dependent on calculated times for each breeding cycle and island. Times visited will be dependent on weather and sea conditions, tidal times as this will determine safe access to the islands.

Long-nosed fur seals are annual breeders with breeding typically occurring in summer (December to February) and pupping peaking in the warmer months. Additional surveys may occur year-round to record occupancy and habitat use outside of the breeding season.

Once the date of the beginning of the pup season is either known or estimated a well-timed count to coincide with the maximum number of pups (about one month before the pupping season ends) should occur (Shaughnessy *et al*., 2011). Repeated counts across the breeding season will improve the accuracy of the counts and increase the confidence in the maximum count if the colonies are easily accessed and resources allow (Goldsworthy *et al*., 2009). Ideally, a minimum of three counts during the breeding season per colony is ideal. An initial visit can be used to estimate the start of the breeding season, and later visits for repeated counts should be 4-6 weeks after the breeding season starts when pup numbers ashore are expected to be near the maximum. Timing of visits will be dependent on weather and sea conditions, and tidal times as this will determine safe access to the islands.

Information on pup size and appearance during counts is critical for estimating survey timing relative to the stage of the breeding season, as this provides a proxy for pup age. Classifying young Australian sea lions can be difficult because moulted pups can be confused with small juveniles of similar size born in the previous pupping season, most of which will be older than 18 months. Newborn pups are very small and black. From about three weeks their fur begins to lighten to a dark chocolate brown. The pup's dark coat is moulted at about five months of

age and replaced by a silver grey and cream colour. Juveniles (born in the previous pupping season moult aged about 18 months) also have a silver grey coat but this shows through their old outer hair, which is ginger coloured, differentiating them from recently moulted pups (Shaughnessy *et al*., 2011). Small juveniles can be recognised by their head shape, particularly their longer noses and should be recorded as juveniles rather than pups.

5.1.2 Protocol

During on-ground direct count surveys, two to four observers conduct a coordinated search following pre-determined transects or routes to cover known pupping areas. If the site is unfamiliar or infrequently visited the likely sites to check may be identified from orthophotos prior to the survey or during an initial survey.

Photograph pups (including any dead) and record their location with a GPS. Pups can be challenging to find as they are often left concealed in vegetation and under rocks or inside caves and crevices. These areas need to be checked carefully and this requires approaching closely (i.e. within 2-5 metres) to count accurately and classify the pups moult stage (approximate age). This is done quietly and as quickly and unobtrusively as possible however pups may vocalise and attempt to move away from observers.

Surveys are generally completed within approximately one hour per colony, but this may vary with the size, topography and vegetation or accessibility of individual islands, the number of individual animals present and the experience and fitness of observers.

ANIMAL WELFARE: The size of the field team should be minimal; groups of animals being approached must have access to an 'escape route'. For older age classes this may be the water but, noting for pups that haven't moulted they will not enter the water so this may be vegetation or rocks that they can take refuge under.

Researchers should minimise the potential disruption of critical social bonds, particularly between mother and pup pairs, and avoid causing disturbance to male mating strategies during the breeding season as doing so can affect a males' lifetime reproductive output.

(a) The survey team moves through the colony as a group or in coordinated pairs, reporting all sightings of pups to one person who enters the count into an application on a digital device (*e.g.* tablet) or scribes the number and age class of each sea lion onto a datasheet.

(b) The pups should be assigned a class (dead, alive - black, brown, moulted, or unclassified) based on their size and the colour of their fur coat (pelage) (see Photos 1-3 and class descriptions).

(c) Dead pups should be marked with spray paint to avoid recounting in subsequent counts. The number of dead pups should be included in the count.

(d) Pup mortality for the pupping season should be recorded as the number of dead pups counted across the pupping season from the birth of the first and last pup during the months that the pup counts are conducted.

ANIMAL WELFARE: Entry into the colony may cause disturbance and avoidance behaviour that may lead to pup abandonment or trampling by bulls. A low profile and an adequate separation distance should be maintained. Consideration should be given to the wind direction as sea lions will detect people entering the colony through olfactory cues. If possible, approaching downwind may avoid them smelling, and subsequently moving or fleeing. Moving slowly and deliberately and pausing, if need be, will minimise the disturbance during on ground counts. Keeping noise to a minimum by using hand signals to communicate and low voices will further minimise disturbance.

Figure 1. Photos and 'black' pup description. Small newborn pups with black hair, may have slight pink colour around nose. Usually applies to animals from newborn-2 weeks of age. Black mate-guarded (pups whose mothers are mate-guarded by an adult male are aged 0−10 days). Newborn pups can be distinguished from older pups by their small size, loose skin folds and relative lack of coordination. In addition, many pups aged less than 3 weeks have a paler crown and dark mask and faint facial markings that give them a spectacled look (Ling 1992).

Figure 2. Photos and 'brown' pup description. Brown pups are approximately 4−16 weeks old and are small to medium size pups brown in colour, usually darker brown on their back and paler underneath.

Figure 3. Photos and description of 'moulted' pup. Pups moult their dark fur at around 16−20 weeks are typically fully moulted by 5 months old. Moulted pups are silvery grey on their backs with a creamy underside, similar in appearance to juveniles but with a wider face and shorter muzzle than juveniles and still have milk teeth.

Figure 4 Photos and description of juveniles. Juveniles are independent of their mothers, fully moulted and are larger in size than the moulted pups with similar appearance. Juveniles are more lean, they are bigger and longer, and they have a different shaped face with a longer muzzle. They also have adult teeth (but teeth may be difficult to see from a distance).

Photo LHS juvenile with RHS moulted pup

Figure 5 Photo of a bull in good body condition with the pale mane on head clearly visible and contrasting in colour to the overall dark chocolate-coloured body coat

and a bull mate guarding a female with pup. Bull with pale mane on head and dark chocolate-coloured coat (in background), foreground LHS young 'black; pup and RHS adult female cow.

Figure 6 Sub adult male note the pale eye ring and lack of pale mane on head, dark chocolate-coloured coat, often brown spots on chest.

Figure 7 Adult female cow, note silvery grey coat and size compared to pup

5.2 Aerial surveys

Not all island colonies will be accessible via vessel for direct ground counts, transport may be by helicopter (i.e. Recherche Archipelago). Landing on these islands must be done away from known pupping sites to avoid disturbance. Where landing is not possible or if disturbance could result in a stampede that jeopardises cows and pups, a 'fly over' at an altitude that does not elicit a response may be a suitable alternative to determine breeding status and to count visible pups. Some islands are too small to safely land a helicopter and for these colonies the survey may be limited to a 'fly over.' Although the height of the fly over is likely to be lower than the 500 m separation distance specified in the Biodiversity Conservation Regulations 2018, a minimum altitude of 150 m should be maintained. This is above the altitude recommended in guidelines for viewing pinnipeds elsewhere and will be adequate to determine if bulls are mate guarding cows and cows are nursing pups (and the relative size of these pups to the cows) to determine at least the stage of breeding if a comprehensive pup count is not possible. Record a count and, where possible, take photographs during the fly over of all areas where individuals are observed for subsequent assessment. During fly overs and for landings, pilots should be able to approach from an altitude and an angle accounting for the wind direction taken that minimises the rotor noise and disturbance.

5.3 Remotely Piloted Aircraft (RPA) surveys with photograph capture

If a combination of RPA and ground survey are to be used, the RPA should be flown first to minimise disturbance. Undertake the ground survey as soon after as possible to validate and corroborate the aerial survey data.

RPAs are restricted to launching from islands or off vessels. Where this is not possible (due to weather/site accessibility) then a helicopter may be used instead. RPA surveys can be undertaken for both species (Australian sea lions and long-nosed fur seals) with small RPAs flown by qualified operators i.e. those that hold a remote pilot licence with CASA (RePL). Examples of RPAs that have been tested and found to be suitable for achieving the necessary photograph quality while minimising disturbance on pinnipeds include DJI Phantom 4 and Mavic 3 Pro (longer endurance than the Phantom and able to fly in windier conditions). Note that the development of RPAs and new technology is rapid and there may be others that will be suitable.

The minimum altitude for a RPA abundance survey is 40 m and follows the peer-reviewed methods of McIntosh *et al*. (2018).

Figure 8 DJI Phantom 4

5.3.1 Protocol

a) Pre plan survey flight path with transects that ensure adequate coverage of the area to ensure that where possibly it is covered in its entirety. Multiple flights may be needed to achieve this for larger areas/islands.

b) Program the RPA using software where the survey flight is planned and pre-programmed (*e.g.* Drone Deploy or Flight application). Example settings include

   Front overlap: 75%

   Side overlap: 60%

   Flight speed: 4 metres/second

   Flight altitude: 40 metres

   Photograph resolution: 1.2 cm/pixel

   Camera facing: Directly downwards (Nadir)

   Photograph capture rate: e.g. 1 frame every 3 seconds, this can be adjusted and will depend on the speed of the drone and the altitude its being flown at to achieve the required overlap between photographs.

   Ensure batteries are fully charged to achieve desired flight time (*i.e.* multiple (4-5) batteries needed for ~1 hour endurance) for the RPA model you are using with payload (inbuilt camera).

c) Fly pre-determined flight path as programmed in the field, noting any disturbance of target and non-target animals during flights.

d) Alternative to pre-determined flight paths, the drone can be flown in manual mode and photographs taken at an appropriate altitude to ensure sufficient resolution. Photographs will need to be stitched together subsequently to account for the overlap between photographs and prevent double counting. Set waypoints may assist in standardising photograph capture to enable comparison between counts from photographs over time.

e) At the end of the survey download photographs and stitch together using software e.g. Agisoft.

f) Import the photographs into GIS software.

g) Overlay a grid to mark, classify species firstly (this is important in areas where both species are found to occur together), then age (and sex if possible) to one of six classes (1) accompanied pup, 2) unaccompanied pup, 3) attendant female, 4) adult male, 5) other, 6) dead. See photos and descriptions below for more detail and add attributes to each sea lion visible in the photograph.

h) Sum count from each photograph to produce an overall count for each age class for the survey.

Descriptions of age/sex classes (Taken from: Hodgson and Holman, 2021 unpublished report)

1. Accompanied pup – a pup with an adult female (i.e. an 'attendant female') within 1.5 m, measured using the shortest horizontal distance between the two animals.
2. Unaccompanied pup – a pup with no adult female within a proximity of 1.5 m.
3. Attendant female – an adult female with a pup (i.e. an 'accompanied pup') or juvenile (i.e. an 'accompanied juvenile') within 1.5 m. If multiple adult females were present, the closest female to the pup was categorised as the attendant female.
4. Adult male – an individual that could be confidently considered an adult male (e.g. by a visible blonde mane/ 'cap', considerably larger with darker pelage than adult females).
5. Other – all other ASL individuals. This included juveniles not in the proximity of an attendant female, females not attending a pup or juvenile, sub-adult males and any other individual who could not be confidently categorised into another class.
6. Dead – dead animals of any age or sex.

See Figure 9 for associated photographs.

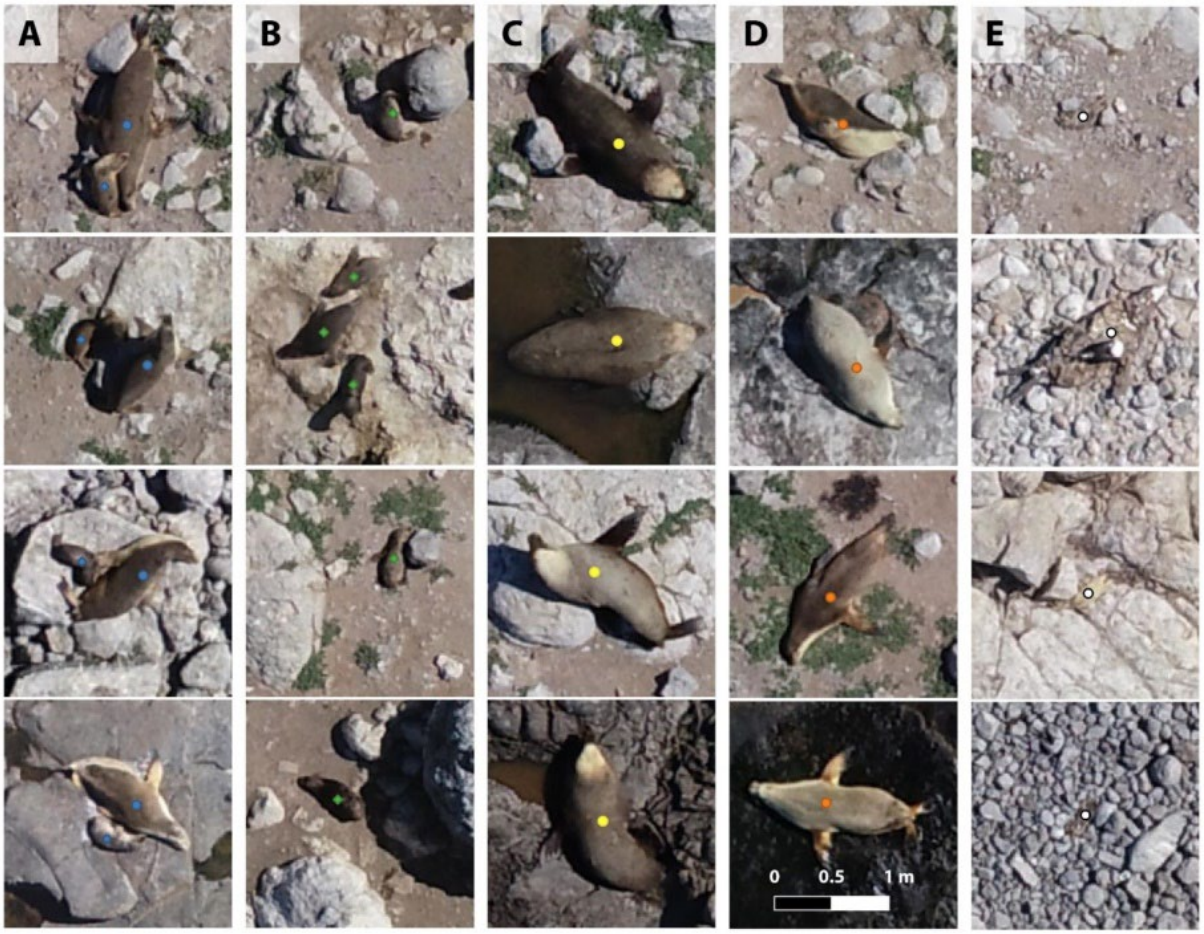


Figure 9. Six different classes, all at the same scale a) accompanied pups and attendant females; b) unaccompanied pups; c) adults males; d) other; e) dead. Figure taken from Hodgson and Holman (2021).

ANIMAL WELFARE:

If pinnipeds appear to react or be disturbed by the drone, for example raising their head or fleeing then immediately increase vertical altitude until they resettle, if they don't immediately resettle then the aerial survey should be terminated.

5.4 Body condition monitoring via handling

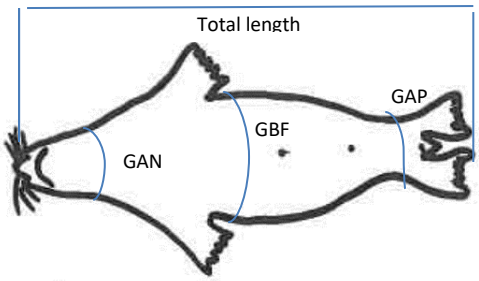
At the completion of on-ground direct count surveys a sub-sample of pups may be hand caught and measured and weighed to get an indication of body condition from morphometrics per island colony. Only pups of <15 kg and not attended by cows should be attempted to be captured by hand.

a) Pups should be slowly and quietly approached and hand caught.
b) This is done by holding the base of the rear flippers and the back of the neck.
c) The pups are restrained by pinning the front flippers with a firm but gentle pressure against the inside of the animal handler's legs and one or two hands holding the pup's

head (see photo below).

d) The pups eyes can be covered with a soft cloth or gloved hands (if one person restraining, eyes can be covered at same time that head is held).
e) A total length and a maximum girth measurement posterior to the flippers is taken with a tape measure and recorded.

Figure 10 Photographs of pups being restrained and measured in the field.



GAN	Girth at neck
GBF	Girth behind flippers
GAP	Girth at pelvis

Figure 11 Diagram of pinniped depicting where measurements should be taken on the body.

f) The pup is then carefully placed headfirst in a hessian weighing bag (the hessian weave allows them to breathe for the short time that they are inside) and suspended (while the bag is maintained a few centimetres from the ground) using a hanging scale to determine weight. A standard hessian 'sand bag' 735mm x 455mm will be suitable for young pups (in the first two moule stages of black or brown and that weigh <15kg).
g) Once weighing is complete, the pup rump fur is clipped with scissors to 'mark' them as handled to prevent stress of repeat handling and to minimise disturbance.
h) The pup must then be released at its point of capture. After checking that it is safe to do so, the handling bag with pup inside is gently placed on the ground and the opening loosened, allowing the pup to exit the bag at its own pace.

ANIMAL WELFARE: Approaching and capturing solitary animals restricts disturbance to individuals rather than groups. Reducing external stimuli by covering the eyes, applying firm but gentle restraint, moving quietly, and minimising noise can reduce the stress associated with restraint.

5.5 Body condition monitoring via RPA

Morphometrics may be collected for other sex/age classes (bulls, sub-adult males and cows) of pinniped remotely from air after the abundance surveys have been completed and only for a subset of individuals. RPAs may also be used to assess body condition, particularly of older age classes of seals and sea lions where there is greater risk of handling to the animal and the handler. The technique is relatively new and the methods are still under development but Hodgson *et al*., (2020) provides some guidance on the appropriate approach and metrics.

a) The RPA should be launched away from (>75 metres) and at a site of the same elevation as the focal pinniped to be measured.
b) The RPA will need to be flown manually and descend to a low altitude approach (20 metres) and positioned directly over the focal pinniped.
c) Some initial photographs can be taken manually (this ensures there are some photographs should the focal pinniped move during the pre-programmed flight).
d) Then a pre-programmed flight should be flown of an area (~15 metres square) centred on the focal pinniped.
e) It is important that there is sufficient front (80%) and side (60%) overlap between photographs to allow measurements to be taken that can be used to calculate volume (mass).
f) Each flight should take a maximum of 10 minutes.

Noting that in the cited Hodgson *et al*., (2020) study, individuals were anaesthetised and measured to ground truth and validate morphometrics derived from the photographs that were taken while the sea lions remained anaesthetised. Photographic measurements have a high level of precision and in most cases, particularly if taken at the time of day where shadows are minimised, result in well-defined edges to the body in the photograph. These RPA derived measurements are also more easily standardised between individuals than measurements taken during handling on the ground.

ANIMAL WELFARE: Reactive responses and disturbance of pinnipeds has been recorded by colleagues that flew RPAs to altitudes lower than 40 metres. As a lower approach may be necessary for morphometrics the potential disturbance needs to be considered and an approach terminated if an adverse behavioural reaction is observed. Some reaction, disturbance and movement is anticipated in response to the RPA hovering and taking photos at altitudes <40 m in pinnipeds, however for the older age classes this approach has a lower risk to animal welfare compared to catching and anaesthetising to measure body condition.

5.6 Mark-resight surveys

Sometimes a more precise abundance estimate may be needed than a direct count. This is particularly applicable for older cohorts (non-pups) that are highly mobile and may be difficult to count directly. Mark-resight surveys and modelling are commonly used to estimate population abundance where a portion of the population is marked in some way. For pinnipeds, this can be done by first marking a number of individuals. With the appropriate approvals (see Section 6), a temporary mark can be applied using human hair dye and a unique identifier (e.g. 2 or 3 digit number) on the side or rump of the sea lion. A metal 'stamp' with numbers cushioned by foam on the end of a 3 m pole is used to apply the marks to the pinniped (Giardino *et al*., 2017). These marks are visible for several months and allow an estimate to be made of the other cohorts of interest (non-pups). This technique is preferable over direct counts as the proportion missed during a direct count e.g. missed because they are at sea foraging, can be incorporated and accounted for in the abundance estimate. It also allows the abundance estimate to be calculated through modelling and therefore gives an upper and lower confidence interval around the best estimate, which is not possible with a direct count. In Western Australia, this has been shown to be effective for the male cohort of sea lions that use the Perth metropolitan islands as haul-outs when not at sea foraging and outside of the breeding season.

Following Giardino *et al*. (2013) and Giardino's personal recommendations, a marking pole has been designed and constructed with a frame and plate at one end on which removable marine grade aluminium numbers (elevated from the plate by spacers) is attached with screws and wing nuts. This system allows easy swapping of numbers during marking. The numbers have a sponge-like foam in the same shape as the numbers glued to them. The recommended hair dye colour is black (ColourU 1 black and Hi Lift creme peroxide 20 Vol - 6%) for sea lions or on pinnipeds with darker coats (Schwarzkopf Nordic Blonde).

While a random sample for marking is desirable to address an underlying assumption of mark-

resight models, sometimes marking will be with biases. For example, only one side of each sea lion may be available to be marked. Attempts to mark both sides could cause significant disturbance to sea lions. The age classes of interest should all be marked, in numbers relative to their occurrence.

Resight surveys must be planned following the initial marking and the frequency and spacing will depend on the mark-resight modelling approach and underlying assumptions. Regardless, of the modelling approach it should be kept in mind that temporary marks will fade with time so they will need to within sufficient time of the initial marking to allow for mark resight. Each resight survey day the number of sea lions present, their age classes and whether they had a mark visible where on the body the mark was sighted and the identifying number recorded (if possible). Additional information on sightability of each individual, including whether both sides, only one side (left or right) or no sides were visible, as this can influence a missed detections of a mark (i.e., sea lions may have been laying on the side marked). Photographs are then compared with the photo identification catalogue to confirm identity, post field and agreement on the identity by at least two people must be reached.

a) The sea lion to be marked should be approached slowly, and from downwind when possible, to decrease the probability of detection.
b) Additional personnel with a 'push pole'(see photos in Section 8 Occupational Health and Safety section below) can be positioned nearby in case the sea lion responds aggressively or other sea lions in the area approach.
c) The mark should be applied via quick but firm (to ensure adequate dye is applied) contact (i.e., duration of a second or two contact between the stamp and fur), and the target should be the flank or rump of the sea lion.
d) After marking the researcher should immediately move away from the sea lion.
e) The marked sea lion must be monitored closely for signs of disturbance before and during the approach and marking. If the individual shows signs of agitation (e.g., sitting up, forcefully blowing through their nose, barking, moving away, etc.) the marker must withdraw immediately, and allow the sea lion to resettle.
f) Sea lions should be re-approached slowly and quietly, with a low profile and the entire body photographed, including the mark, for the resight survey.

6 Competencies

A person who is competent has the knowledge, skills, and experience that allow them to survey pinnipeds successfully, and appropriately manage adverse events as required. Department personnel, and other external parties covered by the department's AEC, undertaking pinniped surveys require approval from the committee and will need to satisfy the competency requirements detailed in Table 1. Other groups, organisations or individuals using this SOP to guide their activities around pinnipeds are encouraged to also meet these competency requirements as well as their animal welfare legislative obligations.

It should be noted that sampling design details such as intensity and scope of the project being undertaken will determine the level of competency required and Table 1 provides advice for standard abundance and body condition monitoring only.

Table 1 Competency requirements for Animal Handlers of projects using this SOP

Competency category	Competency requirement	Competency assessment
Knowledge	Broad understanding of the framework governing the use of animals in research and environmental studies in Western Australia	Training (e.g. DBCA Fauna Management Course or equivalent training). In applications, provide details on the course provider, course name and year.
	Understanding species biology and ecology	Personnel should be able to correctly identify the likely species to be encountered for the site(s) being studied, and have an understanding of the species' biology and ecology. This knowledge may be gained through sufficient field experience and consultation of field guides and other literature.
	Understanding environmental conditions	Personnel should be aware of the environmental and seasonal conditions that may be expected on the project, and understand location-specific animal welfare considerations. In applications, provide details of time spent undertaking similar work in similar locations.
Fauna survey and capture skills/experience required	Experience with pinnipeds	Personnel should be familiar with the animal welfare principles of pinnipeds (e.g. behaviour indicating disturbance and defence). In applications, provide details on the longevity, frequency & recency of experience.
Animal handling and processing skills/experience required	Experience handling pinniped pups and moving around all age classes with minimal disturbance.	Personnel should be experienced at hand catching pups This experience is best obtained under supervision of more experienced personnel. In applications, provide details on experience relating to the expected species or species groups.
	Experience managing disease risk in wildlife management	Personnel should be familiar with hygiene procedures. This knowledge may be gained through sufficient field experience and consultation of literature. Appropriate PPE includes at a minimum long pants, long sleeved shirt, gloves, and glasses (in a field setting polarised sunglasses are suitable) when handling pups. Knee and or shin pads, gators and masks may also be required.

In conjunction with possessing the required understanding and knowledge of pinniped monitoring procedures and animal welfare requirements, a guide to the experience and skill requirements for an animal handler to be considered competent to capture and handle animals is as follows: (noting that some personnel with experience may still require initial supervision in unfamiliar locations or with species that they have not encountered previously):

- Total time in field: minimum two weeks working on pinnipeds either through on ground surveys or pinniped handling directly (e.g. tagging, marking, sampling or measuring condition).
- Recency of time in field: within the past five years.
- Minimum one species of pinniped handled.

7 Approvals

Projects involving wildlife may require a licence/authorisation under the *Biodiversity Conservation Act 2016*. Personnel should consult the department's Wildlife Licensing Section and Animal Ethics Committee Executive Officer for further guidance. In Western Australia any person using animals for scientific purposes must also be covered by a licence issued under the *Animal Welfare Act 2002*, which is administered by the Department of Primary Industries and Regional Development. This SOP complements the *Australian code of practice for the care and use of animals for scientific purposes* (The Code). The Code contains an introduction to the ethical use of animals in wildlife studies and should be referred to for all AEC approved projects. A copy of the code may be viewed by visiting the National Health and Medical Research Council website (http://www.nhmrc.gov.au).

A licence or authorisation may be required under the *Biodiversity Conservation Act 2016* (examples below). Contact the department's Wildlife Licensing Section for more information. It is your responsibility to ensure you comply with the requirements of all applicable legislation.

- Fauna taking (scientific or other purposes) licence (Reg 25)
- Fauna taking (biological assessment) licence (Reg 27)
- Section 40 Ministerial Authorisation to take or disturb threatened species.

8 Occupational Health and Safety

A job safety analysis (JSA) is recommended prior to undertaking any fieldwork, prepared by the field work leader and signed by participants and manager. The following departmental SOPs are relevant to occupational health and safety:

- SOP *Managing Disease Risk in Wildlife Management*
- SOP *Hand Restraint of Wildlife*

If department personnel or volunteers are injured, please refer to the departmental Employee Relations and Safety Section's 'Reporting Hazards, Near-misses and Incidents' intranet page, which can be found at https://dpaw.sharepoint.com/Divisions/corporate/people-services/HS/SitePages/Reporting-

Hazards,-Near-Misses-and-Incidents.aspx

Personal protective equipment should include long sleeves and pants due to the risk of bites from pinnipeds and the risk of injury from vegetation during on ground surveys. Long gators, thick pants, and or knee and leg guards, can also be added for additional protection, particularly in densely vegetated colonies where escape routes may be difficult to navigate during an interaction with an aggressive pinniped and on islands where venomous snakes may be present. Escape routes should be identified and clearly communicated during the team briefing prior to surveys starting.

Push poles can be used during on ground counts to maintain distance between personnel and inquisitive pinnipeds, noting that these can be effective in fending off mock charges but may be ineffective if approached by an aggressive pinniped. Push poles should be metal, reinforced and have a curved end. **IMPORTANT** padding i.e. foam matting material (that does not retain water) must be added to the end to minimise potential injury to sea lion teeth during interactions.

Figure 12 Examples of push poles LHS without and RHS with necessary padding.

A comprehensive first aid kit must be carried in the field that includes supplies to staunch bleeding such as a military-style torniquet. A clear emergency response plan must be included in the JSA that details mean of communication between team members e.g. handheld radio and must include contingency communication e.g. satellite phone and medical evacuation procedures that should be followed in the event of an incident such as personnel being bitten, falling etc.

9 Further Reading

The following SOPs have been mentioned in this advice and it is recommended that they are consulted when proposing to use RPS to survey Australian sea lion breeding colonies and doing on-ground direct counts of pups:

- Department SOP *First Aid for Animals*
- Department SOP *Managing Disease Risk and Biosecurity in Wildlife Management*
- Department SOP *Euthanasia of Animals Under Field Conditions*

For further advice refer also to:

National Health and Medical Research Council (2013) *Australian code for the care and use of animals for scientific purposes*, 8th edition. Canberra: National Health and Medical Research Council.

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11 Glossary of Terms

Adult: oldest age class of pinniped that has reached sexual maturity.

Animal handler: A person listed on an application to the department's Animal Ethics Committee who will be responsible for handling animals during the project.

Juvenile: intermediate age class of pinniped that is immature but fully moulted.

Pelage: fur coat

Pup: youngest age class of pinniped, recently born and can be in one of three moult stages with their pelage/fur coat either 'black,' 'brown' or moulted and still suckling and dependent on mother.

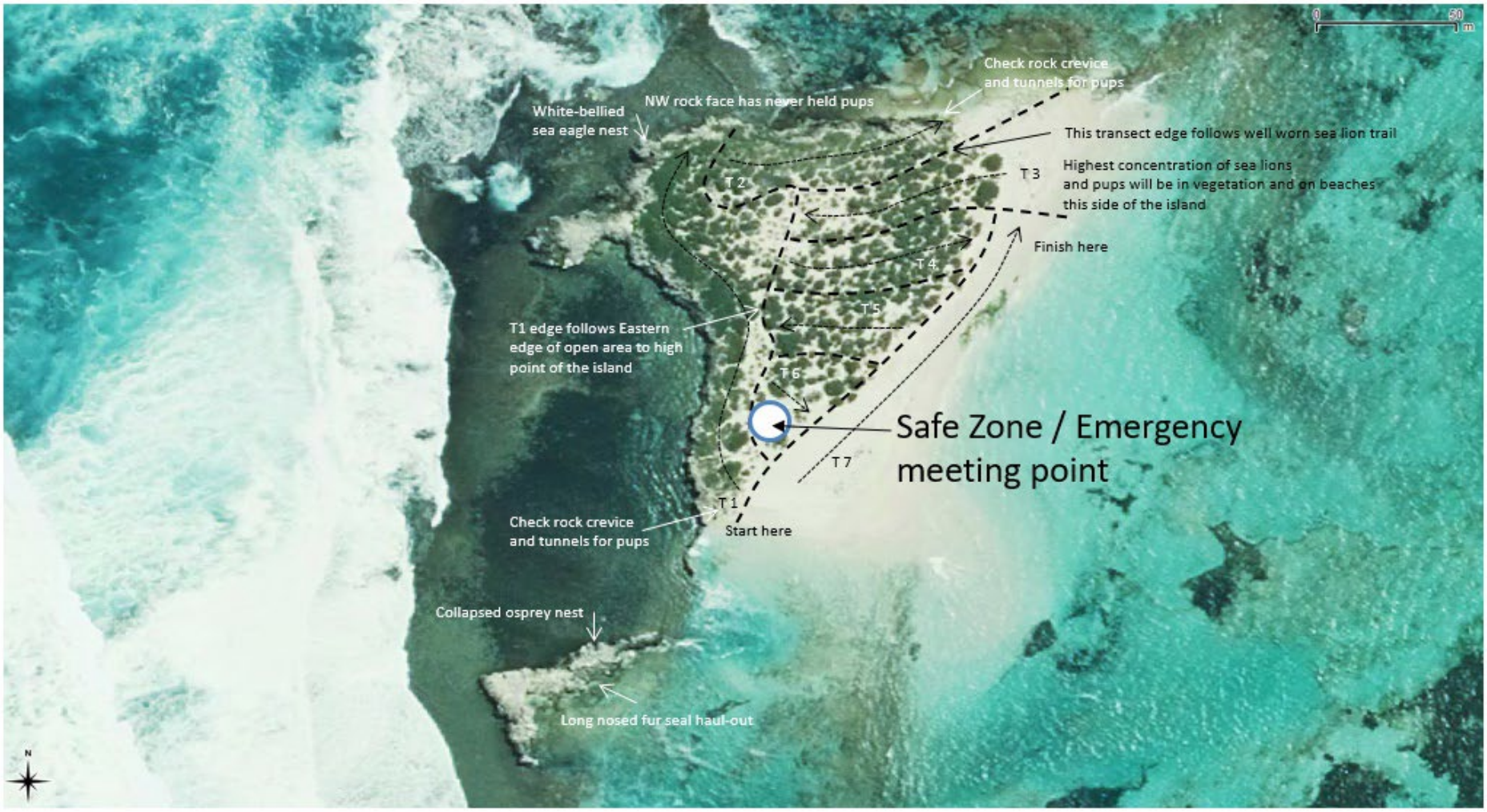
RPA: remotely piloted aircraft

Sub-adult: intermediate age class of pinniped that is not yet sexually mature or adult but is transitioning to an adult, most apparent in male rather than female pinnipeds.

Example site maps

Beagle Island

North Fisherman Island site



Buller Island site