

SoE Inshore Dolphin Offset Strategy – Response to Reviewers Comments 24 November 2014	
Reviews Comments	Response to Reviewers Comments
General Comments	
<p>This section presents my general comments on the <i>Inshore Dolphin Offset Strategy, South of Embley Project</i> (EPBC2010/5642) prepared by Rio Tinto Alcan Weipa. Below I make specific comments on the content of the Strategy with a particular focus on the proposed survey methodology and provide a summary in terms of the Independent Review Criteria approved by the Australian Department of Environment. In general I think the proposed design is reasonable given the specified objectives and duration of the project, the size of the study area, and the budget available.</p>	<p>No change required</p>
<p>The main limitation of the proposed sampling design is that the capture probability likely to be achieved may be too low to fit the most informative robust design models. This is a consequence of the size of the proposed sample area relative to the length of transect that is affordable. I have suggested increasing the sampling intensity of the pre-construction survey to achieve a reasonably precise initial estimate of abundance and to assess the pattern of habitat use to identify more and less often used parts of the proposed sample area so that the size of the sample area might be reduced by eliminating the less frequently used areas and the length of transect per unit area increased in subsequent surveys to achieve a higher capture probability so that more precise estimates of abundance and estimates of temporary emigration and possibly movements between sites might be obtained.</p>	<p>The survey lines have now been changed to 3km apart (rather than 5km apart) and concentrated in areas where inshore dolphins are 'assumed' to be proportionately highest. The revised design aims to increase capture probability in order to fit informative robust design models. Specific details are calculations are provided in the revised Strategy.</p>
<p>Overall, the design is sound and directly addresses conditions 49-55 of the SoE project approval (EPBC2010/5642) although the potential of capture-recapture models to provide really informative estimates would be limited unless the sample area was reduced in size for annual surveys following the first.</p>	<p>The survey design has been revised in order to increase the robustness of capture-recapture models, while also investigating habitat preferences across a representative range of habitats.</p>
Specific Comments on Proposed Methods	
Design Summary	
<p>It is appropriate that “Obtaining information on broad-scale occurrence, distribution and habitat use/preferences within the study area” is set as the first priority for the strategy and that allowance is made for adjustment of the survey design following an analysis of results of the pre-construction survey (p.14). Identification of core habitat at that stage may allow effort</p>	<p>Based on reviewer comments, the survey design has been revised to increase capture probabilities during the pre-construction surveys, at the expense of not surveying some areas of the study area. This omission of some sites (i.e. between Site 1 and 2 and between Site 2 and 3) should not affect investigation of habitat preferences, since other similar habitat types to those</p>

to be better focused in pursuit of more precise estimates of abundance in subsequent surveys. As described on p.10, in view of the expected small population sizes and affordable survey intensity, it is unlikely that it will be possible to estimate significant trends in abundance within the survey period. Nonetheless, with data from the pre-construction survey, it should be possible to estimate the expected precision of abundance estimates from subsequent surveys under alternative sampling scenarios. These are important objectives for the pre-construction survey and, as further discussed below, would be facilitated by more intensive sampling than is planned for subsequent surveys.	being omitted are still being sampled. If time allows, transit lines between sites have been developed to survey the omitted area at less intensity, where the data will be used for habitat preferences, movements and potential revision of survey lines if required (i.e. if a high number of sightings are seen in these areas)
Annual sampling events, timed to the same, weather-optimal period each year is sensible.	No change required
Defining sites with different histories and potential program effects is appropriate.	No change required
While the populations that use the total area may not be neatly partitioned in this way and it may be better to analyse the capture-recapture data as one population for each species, the relative rate of use of the sites and whether that changes over the duration of the project is relevant.	No change required
Although I'm not suggesting that it is required for the Strategy, a social analysis and the areas used by population sub-groups could form part of a subsequent analysis for publication and inform a decision about how to appropriately group the capture-recapture data for abundance estimation.	No change required - Data will be collected in a manner that social structure could be analysed if required
Capture Recapture Robust Design	
As indicated in the last paragraph (p.12), the multistate robust design model provides a useful structure for data collection. As subsequently discussed however, it is questionable whether data collected at affordable cost over an area of this size will support such a model, or indeed any robust design model. Unless per survey effort is increased or the sample area is reduced to allow more intensive sampling on a smaller area, the estimated capture probability may be too small to fit a robust design model or to estimate annual abundance from closed population models without collapsing (aggregating) secondary samples. Under these circumstances, temporary estimation may not be estimable nor heterogeneity of capture probabilities (if present) suitably accounted for.	In order to address reviewers comments, the per survey effort has been increased and sample area reduced to allow more intensive sampling on a small scale.
These considerations serve to emphasise the importance of the pre-construction survey data and the interim analysis of it to potential modification of the design for subsequent surveys.	The pre-construction survey data will be analysed as soon as surveys are completed, with an interim report required to RTA within 20 days (with allowances for analysis requirements if a large number of dolphin groups are sighted and photographed). The results of pre-construction surveys will aid in determining whether modification of the survey design is required.
With respect to the population closure assumption discussed on page 12, as Kendall (1999) argues, provided any movement in and out of the sample area during a sampling period (an annual primary sample of four secondary samples in this case) is random, the estimated abundance from a closed population model is unbiased provided it is interpreted as the number	No change required

of animals that used the sample area rather than the number continuously present there during the period. This applies to abundance estimates generally, including those from a robust design model or an open population model like POPAN. Serious bias in abundance estimates does occur if the probability of an animal being absent from the sample area during a sampling period is not random but depends on its presence or absence during the previous period (i.e., temporary emigration is Markovian) as it may be when breeding cycles and survey site use interact for example.	
The discussion of photo-identification methods and protocols is appropriate. Estimation of the marked proportion is associated with this process.	No change required
Vessel-based Sampling Protocol	
The study area is defined in this section as lying between 12.60°S and 13.35°S as specified in the approvals, and includes coastal, riverine and offshore waters, and waters up to a depth of 25m. While the motivation to sample offshore waters to a depth of 25m may derive from reported sightings to that depth (or more), inclusion of so much offshore water greatly contributes to the total size of the sample area and by attenuating effort, will probably contribute to a lower than desirable capture probability for abundance estimation. At the same time, relatively little is known about the habitat use of these species and there is a relatively large area of relatively shallow water in this part of the western Gulf. Restriction of the sampling area by eliminating a large part of that which is further offshore would only increase the capture probability to extent that the dolphins were more often located in waters closer to shore and the effort per unit area increased in the reduced area. That is presently unknown and gaining such knowledge an important objective for the pre-construction survey. Any decision about the potential of eliminating at least part of the offshore area from subsequent sampling should follow an interim analysis of the pre-construction survey data.	Most survey lines extend to 10km offshore, with only three lines extending out to 15-20km from shore. Given that there is virtually no knowledge of inshore dolphin habitat use in the eastern Gulf of Carpentaria, it is important to survey as thoroughly as possible during pre-construction (given funding and logistical constraints), where revisions may occur after the analysis period. This search effort in offshore areas is particularly important given recent helicopter surveys conducted by the Northern Territory Government, where a number of snubfin dolphins were sighted 10km from shore (Carol Palmer pres. comm.)
As noted above, a relatively large part of the proposed sample area is more than 5km from shore and while it could continue to be sampled it may not be necessary to cover it completely. For example, if it was intended to analyse for differences in habitat use between the riverine, near-shore and offshore areas, there is no need to sample more offshore than near-shore area.	As above
Taking the survey area and transect lines as they're presented in Figure 2, it is useful to assess the 'sample cover fraction' (proportion within which there is a high probability of detection per survey) of the survey area.	The survey lines have been revised to reduce the sample area and increase sampling intensity within this area. Updated calculations on transect line length and study area size can be found within the Strategy.
In order to make at least a rough estimate of expected capture probabilities, we might assume that a large proportion of dolphin groups within 250m of either side of a survey vessel are likely to be detected. In that case, the vessel 'covers' a 0.5km wide strip and an area of 1km ² per 2 km of survey. Information supplied separately indicates that the total length of A transect (see Figure 2) is 308km, the total length of B transects is 297km and the total length of riverine transect is 98km, and that secondary samples will alternate between the A transects plus the riverine transects	

(406km) and the B transects plus the riverine transects (395km). Secondary samples of 400km in length would 'cover' approximately 200km ² or 11.3% of the total sample area (1768km ² , p.12). Consequently, if the assumptions above are reasonable, there is a reasonably high probability of detecting about 11% of all dolphin groups on the sample area in a secondary sample.	
While there are many factors between the proportion of groups detected and the proportion of the population captured by photo id, only a proportion of the dolphins seen will be captured by photo-id. My experience suggests that it is possible that around 50% of the dolphins seen may be captured, although this is variable depending on species, group sizes and sampling protocols. Following this rough estimation process suggests that a capture probability of around 0.05 to 0.6 may be obtained from a secondary sample taken from about 400km of transect.	
1. Increase the length of transect per secondary sample	Given the large study area, logistical and financial constraints, it is not feasible to increase the length of transect per secondary sample
2. Collapse over a set of secondary samples to obtain a single capture probability for the set	The survey design has been revised to minimise the requirement to collapse sets of secondary samples. This option is not ideal, although may eventually be required depending on capture probabilities and proportion of individuals within a group that are photographed (i.e. groups may avoid the boat which would make photo-id difficult if not impossible)
3. Reduce the total survey area and locate the transect lines closer together within the reduced area	This option was selected as the most feasible to increase capture probabilities. The revised survey design is now shown in the revised Strategy, where three Sites are separated by transit lines.
These are very approximate estimates but they do provide a general indication of what might be expected given the proposed level of sampling effort per unit area. As indicated above, the results of the pre-construction survey will be very useful to making decisions about where to focus sampling effort in subsequent surveys. It would also be desirable to derive a useful (reasonably precise) initial abundance estimate from the pre-construction survey data. If it were considered affordable, the potential of the pre-construction survey to serve both of these purposes would be greatly enhanced by either a) increasing the number of secondary samples for the pre-construction survey from four to six so that the data could be collapsed over three secondary samples to obtain a reasonably precise abundance estimate from a two-sample model or b) introducing a third set of transects C to supplement the A and B transects (12 days' sampling) to achieve a similar result from four secondary samples. The latter b) may be preferable as the same transect lines, albeit of shorter length or in a reduced area, could be followed in subsequent surveys which would provide a consistent pattern for analysis of the habitat data throughout the period of the study.	Given the large study area and financial and logistical constraints of this project, it is not possible to increase the number of secondary samples from four to six, nor introduce a third set of transects
Sampling Intensity - Primary Samples	
With suitable detection rates and consistent, transect-based effort it may be possible to fit a robust design model to the capture-recapture data for the whole area or a multistate (multisite) robust design model to sub-areas. This is a very informative model, in particular in respect of the capacity it provides to estimate temporary emigration. A robust design model can be fitted to data on two secondary samples per primary sample should it be necessary to collapse over secondary samples as discussed above and, if capture probabilities are found to be similar over	No change required

secondary samples within a primary sample a single estimate for a whole primary sample may be found to be a reasonable fit in a reduced parameter model. This was the case for humpback but not snubfin dolphins in a recent large scale robust design study on these species in the Darwin region (Brooks and Pollock 2014).	
While, with the sampling effort proposed, it is unlikely that heterogeneity of capture probabilities will be able to be accommodated, heterogeneity has not been significant in models on data on these species in my experience. Estimates of temporary emigration provide information on the proportion of a population that used a sample area during a primary sample and the proportion which were elsewhere (off-site) during the period. The home range of a population is generally unknown prior to sampling and, unless it is very large, a sample area is unlikely to exactly correspond with or include an entire home range. The temporary emigration estimates represent a way of allowing for this and indeed, a justification for restricting sampling to an area of likely focal habitat.	No change required
If it was found in the pre-construction survey data that the coastal areas between the three sites were relatively little used and removed from the sample area in an effort to increase the intensity of sampling, the multistate version of the robust design would provide estimates of the rates of movement (proportions of the population that moved) between the sites between primary samples. This has a similar function to temporary emigration estimates in the sense that it helps account for use of parts of a home range that were not sampled.	Based on reviewers comments, the regions between sites have now been removed and replaced with transit lines, in an effort to increase the intensity of sampling, while still addressing the objective of habitat preferences by surveying transit lines when time allows.
Five annual primary samples as specified on p.15 is appropriate whether a robust design or POPAN model (on collapsed data) were fitted to the data.	No change required
The last paragraph on p.15 may be describing a process of collapsing data over pairs of secondary samples within primary samples as described above but is not explicit about this. In respect of having only two primary samples, unless each is of greater intensity than presently proposed, neither the pre-construction nor post-construction primary samples is likely to yield an abundance estimate with suitable precision. If my suggestion of increasing the survey effort for the pre-construction survey were adopted, and if this were supplemented with a similar post-construction survey, reasonably reliable abundance estimates should be possible for these two primary periods. A decision about this could follow analysis of the pre-construction survey data. Reliable estimates of snubfin dolphin abundance were obtained in the Darwin region but were possible only for the whole area (but not the sub-sites) and meaningful only because it was possible to estimate temporary emigration: large proportions of the snubfin population were off-site in some primary samples.	A final decision about the post-construction sampling design will be made once the pre-construction surveys have been completed. The post-construction surveys will either follow a similar design to the pre-construction and construction surveys (preferred), or separated into 2 lots of secondary samples (i.e. one each year for two years), if data and funding allows.
Sampling Intensity - Secondary Samples	
Brief comment in passing: if a large number of dolphin groups are sighted that would indicate a relatively large population on which abundance estimates of the same precision may be obtained with a lower capture probability than for a smaller population.	No change required

While whether effort is focused on habitat use or abundance estimation is a judgement call, both require sampling with suitable intensity and estimates of both with reasonable precision should be possible from the same survey design. Reducing the number of secondary samples per primary sample would reduce replication for a habitat model and the precision of the estimates just as it would for a capture-recapture model for abundance.	Based on reviewer comments, the design has now been revised to increase the probability of obtaining robust abundance estimates, while still adequately addressing the habitat/use preferences objective.
Habitat Preferences	
This study proposes to sample much further from shore than the Darwin site covers. A very high proportion of humpback dolphins were found to be present within the close-to-shore / riverine area in a primary sample in that area although the proportion of snubfin dolphins estimated to be off-site was sometimes high. It is not known whether the snubfin dolphins that were off the Darwin site during a primary sample were further from shore or further along the coast. It makes sense to me that the pre-construction survey over the entire proposed area be employed to make decisions about the area to be surveyed in subsequent primary samples than to make an up-front decision to always sample the entire presently proposed area. While the habitat favoured by snubfin dolphins may indeed include deep holes in shallow waters further from shore, relatively few may be sighted further from shore within the proposed sample area.	No change required
Training Workshops	
The proposed training workshops and sea trials are necessary. They should be adequate provided the majority of the crews are experienced. It is reasonable to expect that training of less-experienced researchers will be ongoing on survey.	No change required
Indigenous Engagement and Employment	
I'm far less familiar with the area of indigenous engagement than the proponents of the Strategy and would prefer to leave any judgement about the adequacy of the plan proposed for indigenous engagement and employment to others.	The numbers of Traditional Owners to be involved in the surveys has been added to the Strategy. 6 TOs in the first instance, 2 from Napranum and 4 from Aurukun
Informing the Marine and Shipping Management Plan	
Two implications of the intention to use the findings of the surveys to inform the Marine and Shipping Management Plan are that a) the area around Boyd Point should probably continue to surveyed even if it is decided after the pre-construction survey to reduce the total sample area and b) the results of the pre-construction survey assume an even greater significance considering that reliable estimates available at this stage would contribute to the extent that they will be informative in this context.	No change required
Targeted Outcomes Benchmarks and Goals	
The targeted outcomes, benchmarks and goals are appropriate and should be attained with the proposed survey design.	No change required

Performance Indicators	
The performance indicators are appropriate.	No change required
Reporting and Implementation	
The plans for reporting an implementation are appropriate. The plan to prepare summary reports following each primary sample is good, with the pre-construction and final reports assuming greater significance than other interim reports.	No change required
Accountabilities and Responsibilities	
The statement of accountabilities and responsibilities is appropriate.	No change required