UNIVERSITY OF Miami

February 27, 2001

Dr. William W. Fox, Jr.
Director, Office of Science and Technology
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

Dear Dr. Fox:

The Center of Independent Experts has completed another review. Dr. Don Siniff evaluated the methodology used in the assessment of the population dynamics of the Hawaiian monk seal. His efforts included reading relevant documents provided to him in advance, a series of meetings with scientists in Honolulu, Hawaii, from November 30 to December 2, 2000, and a final report that is enclosed. It is my understanding that your office will forward the document to the appropriate places in NMFS.

This report is one of two, non-consensus reports conducted on the Hawaiian monk seal; the other report, completed by Dr. Don Bowen, was sent to your office earlier this week.

Sincerely,

Robert K. Cowen

Robert K. Cowen
Professor and Maytag Chair of Ichthyology

C: Steering Committee Members
David Die
Liz Clarke
Allen Shimada

Encl: Review

Rosenstiel School of Marine and Atmospheric Science
Division of Marine Biology and Fisheries
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
305-361-4182

Fax 361-4600

Email: mbf@rsmas.miami.edu

Population Assessment of the Hawaiian Monk Seal

External Peer Review

Prepared for the University of Miami Independent System for Peer Reviews

February 15, 2001

By

Don Siniff

Executive Summary

The author of this report and Dr. Don Bowen, met with NMFS staff in Honolulu from November 30 to December 2, 2000 to review methods used to document the population dynamics of the Hawaiian monk seal. Many documents pertaining to this subject were sent to us prior to the meeting as well as those provided during the meeting. The collection and analyses of assessment data were examined in detail and recommendations have been proposed on pages 10 and 11of this report.

The primary data used to estimate vital rates and population trends come from sightings of permanently and seasonally marked seals at each of the six sites where most of the pups are born. Many of the recommendations in this report are concerned with using the existing database to investigate alternative methods to estimate population abundance and the vital rates. It seems many of the methods of analysis currently used have developed with the program over time and have become established and inflexible to change, and thus new methodologies have not been explored fully. However, it seems to me, that while in need of improvement, the analyses to date have provided a good basis the current conclusions about trends in the number of monk seals at individual sites and for the population as a whole.

With respect to the above considerations and seeking a way to improve existing procedures while providing participation and feedback among interested parties, I have recommend two small workshops. These workshops should consider: a) mark-recapture models to investigate the current "state of the art" methods that can be use to extract more information and statistical estimates with measures of precision from the data base, b) how to deal with the assessment of the growing monk seal population on the Main Hawaiian Islands. It is important to emphasize that I feel these workshops should be at the level of 3-5 people. In the case of the mark-recapture workshop, I feel the participants should be prepared to explore different models using the existing data base, and develop recommendations based on the results of these analyses. With respect to the workshop to deal with the expanding population in the main Hawaiian Islands, participants should be prepared to explore both policy and assessment issues.

Finally, in our discussions it became apparent that the time the staff of the program spent on planning the field programs, meetings with committees and interested scientists, and in preparing reports, was excessive. It would seem that measures need to be taken to give the staff more time for analyses and preparation of papers for the peer reviewed literature. This would serve both to promote excellence in population assessment methodology and to further develop the expertise of NMFS staff. Also, in this regard I have recommended the addition of a staff member expert in the area of population dynamics and data analysis. This will serve both to promote excellence in population assessment methodology and to further develop the expertise of NMFS staff.

Introduction

From 30 November through 2 December, 2000, Don Bowen and I met with scientists from the NMFS monk seal program to review methods used to assess the Hawaiian monk seal population. This review was in response to contracts we were given which stated that we were "Responsible for the review of methods used in the assessment of the Hawaiian Monk seal population status (stock assessment process) and determination of relevant information on the population dynamics. Also expected to determine whether methods of estimating Hawaiian Monk seal population abundance and demographic trends are reliable." During our meetings, we were provided a very complete review of the program. I am grateful for the time they took for this process and care that was shown to insure complete coverage of all aspects of the program. The recommendations contained herein suggest areas where I feel changes in the program would be helpful. Appendix 1 gives the agenda that was followed during our discussions.

Population assessment and status

The estimation of the population numbers and trends, and the birth and death rates that are generated from these data, usually are considered the main focus of population assessment. While this represents the major emphasis, often population assessment needs encompasses an attempt to understand the causes underlying demographic change. This understanding is often critical to the development and implementation of management measures, and certainly, in the case of the monk seal, attempts should be made to include studies that promote such an understanding.

The Hawaiian monk seal population is widely distributed among the islands and atolls in the Northwest Hawaiian Islands. It also seems to be increasingly present on the main Hawaiian Islands, particularly those of Niihau and Kauai. Pups are mostly born at six sites within the Northwest Hawaiian Islands. A small number of pups are now born on the main islands of Hawaii and it seems likely that these numbers are likely to increase in the near future. The species exists in reasonably discrete populations. This structure could be considered as a metapopulation, with each sub-population having different population dynamic qualities. Each sub-population is subjected to human impacts, but at different levels of disturbance, and all are subjected to various stochastic environmental events.

In 1976, this species was designated depleted under the Marine Mammal Protection Act and endangered under the Endangered Species Act. Critical habitat was designated in 1988 from the beaches to a depth of 37 m around breeding islands in the Northwest Hawaiian Islands and Maro Reef. Mean beach counts at breeding sites indicate that the size of the population declined through the 1990s, mainly due to a sharp decrease at French Frigate Shoals, the largest breeding colony, although there has been little change at French Frigate since 1995. The 1999 beach count index of abundance indicated a minimum population size of 1300-1400 individuals (Honolulu Laboratory, External Program Review 2000, August 22-24)

Methods of data collection

a) Counts

Data are collected from counts and identification of individually marked seals by walks through each sub-population. These walks are identified as "censuses " or "patrols". Censuses

are counts of all monk seals hauled out or seen in nearshore waters around an entire island or atoll at certain time intervals during the season. These counts usually are completed for the entire site within the same day. They begin about 1:00PM for Laysan and Lisianski Islands and earlier at the atolls because the travel time required is longer. Given its size, censuses often occur over a two-day period at French Frigate Shoals. Data are collected on all seals sighted, but only those seen on land are used to generate the "beach count". The mean of a series of beach counts at each site is used as the index of abundance to examine long-term trends. Appendix 2 gives a sample of sightings of adult males in 1982, by census number, from censuses for Lisianski Island (Stone, S. H. 1984 Hawaiian Monk seal population research, Lisianski Island, 1982, NOAA Technical Memorandum NMFS, August 1984), and although these data were collected more often than is usually the case, this Appendix does present a good general picture of the sightings obtained during censuses. Patrols are surveys that take place at any time and the focus is on obtaining behavioral data, identifying and marking animals, and collecting spew and scat samples. (NOAA Technical Memorandum NMFS, T. Johanos and J Baker, The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1999). Sightings of identifiable seals during both censuses and patrols are also the basis for estimation of reproductive and survival rates.

In addition to observations during censuses and patrols, other data are collected during a normal field season. It is usually considered that all pups that survive to weaning are tagged with two tags in the rear flippers, seals not previously identified are classified by size as juveniles, subadults and adults, and are usually dye marked or identified by scars or other natural marks. Using these marks and tags, it is felt that most of the individuals over the course of the field season each year are identified.

The use of the mean beach counts over several censuses provides a relatively consistent series to examine long-term trends in abundance (this was the method originally developed when monk seal population studies began) within sites and for the population as a whole. However, they do not provide an estimate of total population size, and they can be strongly affected by many influences as can easily be seen in Appendix 2. A cursory examination of these data indicate the problems associated with using an average of several beach counts for an index of trend. Such factors as the temporal changes that occur throughout the season and the changes in behavior with molt and no doubt other seasonal events, emphasizes the need to consider several approaches in analysing these data. The beach counts appear to provide the only comparison with historic counts as an index of long-term population trends and certainly should be continued. It is just that, much more information could be extracted from these data through more complete analyses using mark-recapture models or other types of models to obtain estimates of vital rates that allow estimates of precision.

The total population of monk seals is obtained using the cumulative number of marked individuals at each site and is used as an estimate of the minimum population at each site. As researchers spend many months at most sites continuously marking unmarked animals throughout the season, it is assumed that there is a close relationship between this minimum estimate and total population. This may be true for most sites but it certainly depends on how long the site is occupied. For data given in Appendix 2, I divided each month in half, and counted the number of new adult males that entered the counts up to September. Plotting this curve shows that a significant number of new seals were added each half month up to early July. Then an obvious asymptote was reached. Obviously this was a simple exercise, but it did show that some period of time is required before the asymptote is reach, so the time of year and time

span of the counts are obviously important. It seems certain that each sex and age group, and perhaps each site, may require different time windows and length of time for the asymptote to appear and for some sex /age groups (probably the juveniles) it may be found that this method of approximation may not work very well.

In considering the data collected during censuses and as shown in appendix 2, it seems mark-recapture models should be investigated to extract more information from these data than is currently the practice. There are complications in the monk seal sighting data. For example, individuals have different sighting probabilities within each census and over time, but some of this variance can be assigned to differences in sex and age class behavior. Mark-recapture models do exist that can accommodate some problems with sighting probabilities where correlates for correction exist. To date, it seems that these models have not been investigated. Therefore, I **recommend** that mark-recapture methods be investigated as a means of extracting more information from the valuable sighting data collected during censuses and patrols and that this could most effectively be done using a small workshop attended by scientists expert in mark-recapture theory.

b) Survival and reproductive rate estimates

Jolly-Seber (Craig, M.P. and T.J. Ragen. 1999. Body size, survival and decline of juvenile Hawaiian monk seals, *Monachus schauinslandi.* Marine Mammal Science 15(3):786-809) estimation methods, using any individual identified as alive in any given season as the input matrix, are used to obtain annual survival estimates. Survival of pups to weaning each reproductive season is estimated from the observations during the censuses and other activities. The survival rate to weaning is calculated as the ratio of the number known born to the number identified as surviving to weaning. It is assumed all pups born are seen at some point in the observations. Survival to weaning maybe a bit uncertain, as some pups disappear and thus an assumption is made about their final fate. In such cases, a judgement about survival is made based on previous observations as to the pup's condition and age.

The estimation of reproductive rates is based on sightings of identifiable seals. Reproductive rates are given for "parous" females, defined as animals that were known to have previously reproduced, and for all females classified as adults during the particular field season. Obviously this latter calculation might include juveniles who have come into estrous for the first time. For two sites, Laysan Island and French Frigate Shoals there are enough known aged females so that estimates of age-specific birth rates are available.

When movements among sub-populations occur, the island of residence is assigned based on where the pup was born. For other individuals that move among sites, the most common location is used as input for the Jolly-Seber calculation of survival.

Based on history, mostly on disturbance during the historic military occupation of The Islands, monk seals have been designated as extremely sensitive to human presence. Because of this, during censuses and paroles extreme care is taken to avoid disturbance of individuals. For example, animals are only dyed with bleach while they are sleeping and during censuses animals are not disturbed if tags, dye marks, and natural scars are not visible because of the position of the body or rear flippers of the seal. Because of this practice, marked animals may be present in

the population that season, but recorded as missing. This certainly introduces bias into the estimation of the reproductive and survival rates. The degree of this bias is probably related to the frequency of the census periods, and the length of time a sub-population is monitored during the season. Again, it would seem useful to use existing data such as shown in appendix 2 to explore, in a model, different sampling intervals and procedures to examine the contribution of this potential bias to rate estimates. Obviously some imagination is necessary here to create a model with estimates of survival and reproduction that would project such data over time, and then sampled using different protocols. Currently, it is assumed that very few identifiable animals that come to a study site are not identified in a given season because of the frequent observations periods. However, in looking superficially at the records it can be seen that some animals could easily be missed in some years. Thus, I **recommend** that an analysis of existing data, using some simple models, to determine how estimates might be biased by missing animals that are really present.

In considering the problem of missing animals, the conclusion that is reached is that this is a result of the practice of trying not to create any disturbance on the beach. Many populations are of seals are studied using marked animals, and all that I am aware of are willing to disturb animals sufficiently to read tags or marks during censuses. This type of disturbance is assumed to not cause any disadvantage to individuals with respect to survival or reproductive performance. Although I have not worked with monk seals and I have often heard the explanations of how different monk seals are from other species, I still hold the opinion that a small amount of disturbance to identify marked individuals when they are present would not disadvantage individuals. I would suggest that some experimental work be done to see if indeed there is disadvantage from such disturbance, and if this can not be demonstrated, then field procedures be changed to identify marked animals when present. Further, it was not clear to me how such animals are currently entered into the data base when present but not identified. How these animals are currently treated could influence estimation of vital rates, and this certainly needs to be considered. If there is a category "marked but not identified" investigation into how this category changes over the season might give further insight into this problem.

c) Marking

As mentioned above, marking individuals creates the basis for the estimation of all the population vital rates. Therefore, it is important that individuals are reliably identified over annual cycles. Flipper tags are the main means of identifying seals on an annual basis. Flipper tags are the standard tools used on most seals, and the problems encountered are well known. Foremost among these limitations, is tag loss. Researchers attempt to avoid this problem by double tagging individuals and replacing tags that are lost on animals. This has also been the pattern with the monk seal program. A different problem facing monk seal researchers has been that the number on tags may become unreadable due to the abrasive on the sand. Given that some tags are lost and others become unreadable, it is important to understand the effect of tag loss on estimates. However, it does not appear that a review of monk seal tag loss has been carried out. Therefore, I **recommend** that an analysis of tag loss be conduced and since there exist models to correct for tag loss I suggest that these corrections be considered for application to the rate estimates.

With respect to tag loss and wear, the use of temple tags may be exacerbating the problem. These tags must be placed on the trailing edge of the flipper webbing where they are constantly

exposed to abrasion from the beach sand. Also, in my experience, temple tags are more difficult to apply than other types of tags used by seal researchers and therefore their use may increase the overall duration of disturbance to individual seals. I **recommend** that other types of tags, such as Roto-tags and Allflex tags, be investigated as a replacements, as these tags can be place high in the flipper webbing thus reducing wear, and are easier to apply.

d) Movement among sub-populations

There seems to be significant movement between some of the sub-populations. This movement has been noted in the data collected and each marked individual is assigned to one island population so duplication does not occur. However, the influence of this movement might be significant if there are a number of unmarked individuals in some of the island populations that move between locations. The potential influence of such movement on population parameters, for each sup-population, does not seem to have been explored fully. Some notion of this influence might be available by using a simple model, and assigning immigration and/or emigration rates observed on marked animals to unmarked animals, and observing the result on the data collected. Further, examination of these data might also be useful in determining if the current designations of the sub-populations are appropriate from a demographic point of view. Significant movement of adult females might mean that some sites, such as the Kure, Midway and Pearl and Hermes reef sub-populations, could be combined or, at the least, are more likely to have similar vital rates. Such an analysis could influence the logistic support needed to obtain demographic data from the metapopulation. Therefore, I **recommend** a more complete analysis of movements be made with a view toward how these findings might affect parameter estimation for the sub-populations, and how this movement might influence the procedures used, and logistic support required for population assessment.

e) Population models

The Hawaiian monk seal program has used age-structure population models to help in research and management decisions since the mid 1990s. Several models have been developed for different purposes (T. Regan, unpublished, Starfield A.M., J.D. Roth and K Ralls. 1995. "Mobbing in monk seals: the value of simulation modeling in the absence of apparently critical data. Conservation Biology 9(1):166-174)). Recently, the "Regan" population model has been modified by D. Goodman and A. B. Harting of Montana State University. This model begins with age structures for each site that are obtained from data from known-aged plus minimum-aged seals, survival rates obtained from estimates from each site, and age-specific reproductive rates from Laysan Island and French Frigate Shoals. Because age-specific reproductive rates are not available from the other sites, the Laysan Island and French Frigate rates are used for all sites.

This population model, currently, is very comprehensive. It provides a framework to explore management options such as adult male removal when mobbing behavior is observed, (although this is what the Starfield et al. model did) and for exploring the influence of shark predation on juvenile survival. Although such explorations might be useful it must be remembered that in these explorations the parameter estimates that are used, determine the results produced and obviously caution is needed in these interpretations. The model is flexible in that parameter values used can be changed for each sub-population. However, it seems to me that more work needs to be done to explore the effects of the potential biases in data collection and analysis

procedures, before a lot of faith can be placed on the results that are obtained from any simulations derived from this model. I **recommend** that more simple models be developed, using the existing data bases, to explore the range of values that might be expected in parameter estimates. Once a more complete analysis of the contributions of potential biases to parameter estimates has been attempted, then this model could be used to help understand if the estimates of the vital rates are consistent with the current dynamics of the various sub-populations. For example, do the estimates of age-specific reproductive and survival rates give growth rates of sub-populations that match what has been observed?

The model allows the incorporation of a density-dependent function that requires the establishment carrying capacities for each sub-population. This seem very undesirable because we know little about potential carrying capacities, and the model output gives the impression that these populations will move to these fictitious levels and become stable. However, we recognize that some form of density dependence will likely operate on sub-populations and therefore research in this area will be needed. This research will be difficult and by nature multi-disciplinary. Therefore, I would suggest that this part of the model be set aside, with respect to results that might be used in management decisions, until further research on carry capacity is conducted, and a fuller understanding of this carrying capacity for each sub-population is realized.

With respect to research on carrying capacity, it seems to me that there are many lessons that can be learned from the French Frigate Shoals experience. It seems likely that the declines here were related to either exceeding the carrying capacity or changes in resources brought about by outside causes. Further consideration of these data might give insights into what to expect from other sub-populations as populations grow.

Program management

a) Data collection and management

The data collection procedures used by the Hawaiian monk seal program are well documented in a thorough field manual (Marine Mammal Research Program, NMFS Honolulu Laboratory, 2000 Field Manual for Research on the Hawaiian Monk Seal). The manual serves as a working document (i.e., it evolves over time as required) with the following objectives: 1) training and orientation of research staff, 2) standardization of all field research procedures, and 3) the provision of an annual record of field methods used. This manual is very comprehensive. On first examination of this document it seems somewhat excessive in it's coverage, however, after the in-depth review of the program, it was easy to see that this document was a excellent field manual, and certainly a necessary item for each field team.

While in the field, data entered into a simplified version of a relational database. This permits errors to be corrected while animals are still available to be resighted. Once back in Honolulu, each site leader is responsible for further data auditing and producing a written summary of the data collected at their site. These summaries are combined into a NOAA Technical Memorandum to serve as a reference for the research conducted each year. Audited field data are then loaded into an ORACLE database by the database manager, backed up, and secured. New field computers are going to become available that will allow the entire database to be taken

into the field so that a more complete checking of entered data can be accomplished. This development is an excellent advancement and I suggest that every effort be made to enter all data into the database while investigators are in the field. This advancement may require new data entry software which might initially have "bugs", thus every effort should be made to completely test this new development before the new computers are sent to the field camps. In the future, the use of handheld data-entry computers might be considered, but this development again will require extensive testing before it becomes field operational.

b) Field research logistics

The monk seal field program is certainly challenging to execute because of the logistics involved in supporting 6 remote field camps, often separated by considerable distances. The population assessment data are usually collected over periods of 3 to 6 months, depending on site, by about 18 researchers in teams of three. One person is designated as camp leader at each site. Temporary field staff members, hired through the Joint Institute of Marine and Atmospheric Research (JIMAR) at the University of Hawaii, Honolulu, collect much of the field data. The camp leader may be a JIMAR or a NMFS employee. It seemed that this arrangement was satisfactory to all concerned, but perhaps unusual because temporary people hired by a contractor are sometimes in charge of field camps. This arrangement should be review by NMFS as it would seem more desirable that NMFS employees should be designated as camp leaders to provide continuity in data collection and logistic arrangements.

Logistics, purchasing food and scientific supplies for the annual field research puts excessive demands on full-time staff. The monk seal research team has done a good job of finding economies within the context of the current approach. However, given the demands on staff time, I **recommend** that serious consideration be given to finding ways to lessen the time commitment give to provisioning and planning the field camps. This might include contracting the provisioning of field camps to companies that perform such functions on a routine basis, or make this a part of the JIMAR contract.

In the area of Kure, Midway and Pearl and Hermes Reef, there seems to be significant exchange among the sub-populations. It might be useful to examine the possibility of only one field camp and improving the ability for researchers to travel among the locations. This could lessen the overall field commitment and provide better data on the patterns of exchange among sub-populations. Obviously, this option needs to be examined carefully, since the focused objective is to improve data collection while at the same time lessening the logistic complications. It would seem there is ample existing information in the monk seal database to determine if these sites, or other sites, might benefit from this approach and how such an approach might work without loss of data quality. Again, a simple model exploring the various possibilities would seem appropriate.

The trend in the increasing number of monk seals using the main Hawaiian Islands will most certainly require new methods and more effort, above the current commitments of data collection. In this connection, I **recommend** that NMFS consider holding a small workshop, to determine the most appropriate ways to assess monk seal abundance in the Main Hawaiian Islands and discuss how to deal management issues that will arise. The management issues associated with the main islands certainly will complicate assessment procedures. Thus, it may be necessary to deal with planning management actions initially, since the numbers of seals will

be small. Issues such as the legalities and public involvement that will result if seals are moved away from heavily used areas, or harassment to discourage colonization, could be major issues initially. Assessment problems will come later as the population on the main Islands increases. It may sound as though I am "crying wolf" on this issue, but it seems certain that these issues will arise, and become more serious as time passes.

c) Data analysis and productivity

As noted above, the review clearly suggested the staff of the monk seal program are overly taxed with such functions as planning and executing the logistics necessary for the field programs, and other administrative demands. There is a need to be responsive to clients, but some relief is needed if these scientists are to contribute effectively to the peer reviewed literature and gain scientific stature for their work. Such contributions are essential to ensure quality of the program and to develop the careers of the individual scientists. Some of the suggestions of this report might help with some relief. However, it seems likely that these changes will be slow to develop and may not be all that saving in time commitments. Thus, I **recommend** that staffing another position with an individual with good quantitative analysis skills and the demonstrated ability produce scientifically credible papers, is highly desirable.

It is essential that censuses and cohort tagging of pups be conducted annually at each the major pupping colonies. There are many reasons for this which include: 1) The dynamics of the individual colonies differ such that it would be impossible to track, with any confidence, the overall population trends through the use of index sites. 2) The statistical power to detect trends in population numbers would be diminished significantly with less frequent data collection. 3) Obviously, monk seal life histories are tied to annual cycles, and the variance between successive years in vital rates can be very significant (and there certainly are data in the data base to demonstrate this characteristic). Thus, omitting a single year has the potential to miss major events that could easily influence management decisions. There are probably many other reasons why annual assessments of each sub-population are necessary, but it seems obvious that such attention is required at least as long as Monk seals are on the Endangered Species list. Therefore, I **recommend** that the current practice of collecting annual population data be continued, but that efficiencies are sought that do not compromise the ability to track both population size and vital rates.

Summary of recommendations

I recommend:

1. Analyses of the sighting data to examine possible models to estimate sighting probabilities, and that in this context, mark-recapture methods be investigated as a means of extracting more information from the sightings data. This could most effectively be done within the context of a small workshop.

2. A more careful analysis of existing data to determine to what extent vital rate and minimum population estimates might be biased by misidentified and "missing" animals, and within this context an investigation of the effect of tag loss on estimates.

3. The investigation of the use of other types of tags, such as Roto-tags and Allflex tags, as

replacement tags. These latter visible tags can be placed high up in the flipper webbing thus may reduce wear and loss of tags, and are easier to apply.

4. The investigation of simple models, using the existing data bases, to explore the potential biases in current data collection procedures and how these biases might influence parameter estimates. The model developed by Goodman and Harting, be used to examine what range of parameter values are consistent with the current dynamics of the sub-populations.

5. A more complete analysis of movements be made with a view toward how these findings might affect parameter estimation for the sub-populations, and how this movement might influence the procedures used, and logistic support required for population assessment.

6. That serious consideration be given to finding further economies in planning for and carrying out the population assessment field research. This could include contracting the provisioning of field camps and, in certain instances, having single teams cover nearby sites by rotating from site to site. However, in this latter case, it is essential that data collect not be compromised.

7. That NMFS consider holding a workshop to determine the most appropriate ways to assess monk seal abundance in the Main Hawaiian Islands and to deal with management issues that will arise. It may be that an additional workshop may be necessary to deal with the management issues as the population grows, but in the first workshop, it seems certain that management issues will arise since these will likely influence assessment methods.

8. That NMFS staff another position with an individual possessing good quantitative analysis skills and the demonstrated ability to write up the results of population assessment analyses in a timely fashion

9. That the current practice of collecting annual population data be continued, but that efficiencies be considered as long as they do not compromise the ability to track both population size and vital rates.

Appendix 1.

External Review of Hawaiian Monk Seal Population Assessment Program

Final Draft Agenda

29 November 2000

1. Review agenda 0900-0910

2. Distribution of Hawaiian monk seal metapopulation 0910-0930
   a. Northwest Hawaiian Islands
   b. Main Hawaiian Island

3. Marine Mammal Research Program (MMRP), brief overview 0930-1000
   a. Population Assessment
   b. Foraging Ecology
   c. Health and Disease
   d. Marine Debris
   e. Public Outreach
   f. Budget

4. Schedule of field camps 1000-1100
   1. Midway - re-emerging population center (February - August)
   2. First deployment - Laysan/Lisianski (March – July
   3. Second deployment - Pearl & Hermes/Kure (May - July)
   4. French Frigate Shoals (April/May-August)
   5. Counts at Necker/Nihoa
   6. Main Hawaiian Island surveys
   7. Extra camps (epidemiology, satellite tracking, retagging, etc.)

5. Logistics 1100-1200
   1. Ship vs Air
   2. Supplies and equipment
   3. Temporary hires
   4. Camp conditions
      1. Tented camps (Laysan/Lisianski/Pearl & Hermes/Kure)
      2. Permanent infrastructure (French Frigate/Midway)

Lunch - 1200-1300

6. Data collection at annual field camps 1300-1330
   1. Activities
      1. Identification/Bleach
      2. Births/weaning (thoroughness depends on site)
      3. Pup tagging
      4. Pup condition at weaning
      5. Survival Factors
      6. Behavior (Laysan/Lisianski, French Frigate)
      7. Male aggression/injury
      8. Entanglement
      9. Scats/spews
      10. Debris removal
      11. Tag condition
      12. Tag replacement
      13. Necropsies/other specimen collection
      14. Disturbance

   2. Research objectives 1330-1400
      1. Identify all individual seals in each major subpopulation
      2. Determine trends in subpopulation abundance (beach counts and total population)
      3. Assess survival rates
      4. Evaluate reproductive rates
      5. Determine trends in offspring condition
      6. Identify causes of morbidity/mortality
      7. Monitor research related disturbance

   3. Management goals of field activities 1400-1415
      1. Mitigate entanglement mortality
         1. Disentangle seals
         2. Remove dangerous debris from beaches
      2. Mitigate aggressive male mortality
      3. Mitigate shark predation
      4. Detect possible disease epidemics or other events impeding population growth

   4. Primary methods for demography data collection 1415-1500
      1. Standardized protocols and data forms
      2. Beach Counts (basis for abundance index)
      3. Match and maintain ID's using flipper tags, bleach, scars, natural marks. Update ID files with photos and scar ID sketches (excluding Necker, Nihoa, and main Hawaiian Islands).
      4. Engraved temple tags and PIT tags applied after weaning
      5. Standardized data collection on factors affecting survival (shark bites, other wounds, emaciation, entanglement, etc.)

Break - 1500-1530

7. Data Management 1530-1600
   1. Field entry
   2. Post-field editing
   3. Oracle database
   4. ASCII standard files
   5. Standard Fortran analysis programs

8. Annual demography/research summaries 1600-1700

End of day

30 November 2000

8. Use of data 0900-1030
   1. Long-term monitoring
   2. Annual reporting
      1. Recovery Team Meeting
      2. Annual Report "Hawaiian monk seal in the NWHI" - NOAA Tech. Memo.
      3. Stock Assessment Report
      4. Honolulu Laboratory Program Review
      5. Data provided to Marine Mammal Commission for their annual report
   3. Peer-reviewed publications
   4. Input parameters in Monk Seal Simulation Model
   5. Ongoing management/conservation efforts
9. Monk Seal Simulation Model 1030-1200
   1. History (Ralls, Ragen, Harting/Goodman)
   2. Demonstration of model as management tool

Lunch 1200-1300

10 Discussion 1300-1500
   1. Questions/Feedback on assessment program
   2. How to improve efficiency of data collection?
   3. How to lower effort without giving up key data?

Break 1500-1530

11. Open discussion 1500-1700

End of day

1 December 2000

12. Reviewers prepare report with MMRP staff on hand for input 0900-1200

Lunch 1200-1300

13. Reviewers work on report 1300-1600

Adjourn

APPENDIX 2 An example of sighting of individual marked seals taken from data presented in: Hawaiian Monk seal population research, Lisianski Island, 1982, NOAA technical Memorandum NMFS, August, 1984, S.H.Stone.

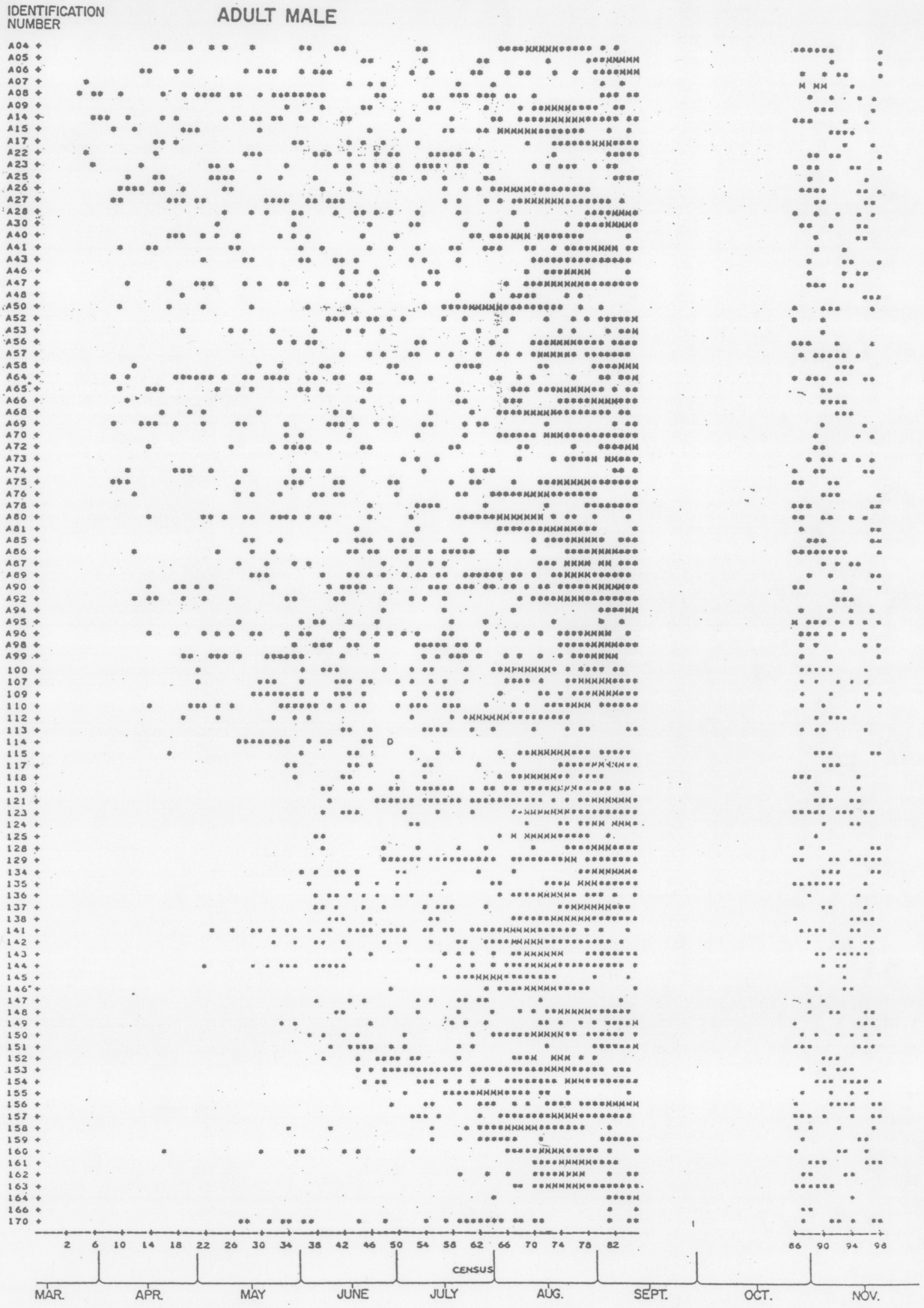

Table 2.--Individual monk seal hauling patterns by census number, Lisianski Island, 1982. (M: molting, B: first census pup observed with mother, P: mother-pup observed, and D: died).

STATEMENT OF WORK

Consulting Agreement Between The University of Miami and Donald Siniff

September 18, 2000

General

Accurate assessment of the endangered Hawaiian monk seal population is a critical component of NMFS efforts to recover this severely depleted species. A recent lawsuit against NMFS is based on the allegation that the lobster and bottomfish fisheries in the Northwestern Hawaiian Islands have negatively impacted the recovery of the endangered Hawaiian monk seal. This controversial issue has heightened the need to ensure that NMFS assessments of the monk seal population are as accurate as possible. A review of the methodology currently used to generate demographic trends may shed new light on the population dynamics of this critically endangered species.

The consultant shall be responsible for the review of methods used in the assessment of the Hawaiian monk seal population status (stock assessment process) and determination of relevant information on population dynamics. The consultant is also expected to determine whether methods of estimating Hawaiian monk seal population abundance and demographic trends are reliable and scientifically rigorous.

Specific

The consultant's duties shall not exceed a maximum total of three weeks- several days to read all pertinent literature and documents, attend a two-day meeting with population scientists at the NMFS Honolulu Laboratory, several days to produce a written report of the findings. Specific tasks and timings are itemized below:

1. Read and become familiar with the relevant documents provided in advance to the consultant, including (but not limited to) the following:
    a. Latest Stock Assessment Report
    b. Hawaiian monk seal field manual
    c. Recent data provided to the Recovery Team
    d. Recent Technical Memorandum (annual reports);

2. Discuss stock assessment methods and conclusions regarding stock status with scientists in Honolulu, Hawaii, over November 28-December 1, 2000;

3. No later than January 8, 2001, submit a written report of findings, analysis, and conclusions. The report should be addressed to the "UM Independent System for Peer Reviews, " and sent to David Die, UM/RSMAS, 4600 Rickenbacker Causeway, Miami, FL 33149 (or via email to ddie@rsmas.miami.edu).

Signed_____ Date_____