

JIMAR, PFRP ANNUAL PROGRESS REPORT FY 2003

P.I. Name: Dan Goodman¹ & Jean-Dominique Lebreton²

¹ Montana State University; e-mail goodman@rapid.msu.montana.edu

² Centre d'Ecologie Fonctionnelle et Evolutive, CNRS, 1919 Route de Mende, 34 293 Montpellier cedex 5, France; e-mail: lebreton@cefe.cnrs-mop.fr

Project Proposal Title: Integrated modeling for Hawaiian Albatross Populations

Funding Agency: NOAA - JIMAR

1. Purpose of the project and indicative results.

The potential impact of longline fisheries on Albatross populations has been a concern (Croxall, 1998) since Weimerskirch et al. (1997) documented the detrimental effect of long-line fisheries on the population dynamics of the wandering Albatross *Diomedea exulans*. Accidental by-catch of individuals of the three North Pacific albatross species (*Phoebastria albatrus*, *P.immutabilis* and *P.nigripes*) has also raised concerns on the impact of by-catch at the population level in these three species. In particular, Cousins and Cooper (1999) reviewed the available knowledge on population biology of the Black-footed Albatross, to determine if by-catch by longline fisheries was detrimental to the species. Similar concerns exist for Laysan Albatross *P.immutabilis*.

The purpose of the present project is to develop integrated population modeling for Black-footed (*Phoebastria nigripes*) and Laysan (*Phoebastria immutabilis*) albatross populations to assess whether past and present levels of by-catch are likely to affect significantly the populations of these species. The first step of the project will review the information existing on demographic parameters, and proceed with further analyses whenever needed. In the second phase, we will develop a Leslie matrix model (Caswell 2001), that will be used as the core of an integrated model using the Kalman filter and combining likelihoods for the various pieces of information available. Specific questions concerning the impact of by-catch, the potential for compensation by accelerated recruitment, the additional impact of accidental deaths in terms of pair re-formation after widowing, etc. will be examined by implementing the corresponding assumptions in the model, and by testing them.

2. Progress during FY 2003. Provide a thorough discussion of accomplishments and problems.

The present report reviews the activity under this contract up to the beginning of April 2003. **Since the subcontract with CNRS has not yet been signed, the work to date has been quite preliminary** and has consisted of 3 main lines of activities:

- Contacts for carrying out the review of the existing information on demographic parameters, and to make decisions on further analyses whenever needed.
- Bibliographic research and development of a Leslie matrix model, that will be used as the core of an integrated model
- Preliminary contacts with people having responsibility for the various sources of data.

These three topics are briefly reviewed below.

a) Estimation of demographic parameters

- A close collaboration has been established with J.D.Nichols (Patuxent Environmental Research Center, USGS) who is presently doing survival analyses based on this material. This part has been delayed due to the data handling difficulties (double banding that had to be sorted out in the data base)
- Establish a comparative data base on survival among albatrosses. Albatrosses are characterized by extreme natural longevity, which means a high adult survival. Adult survival among albatrosses present a variation from 0.857 for *Thalassarche chlororhynchos* to 0.973 for *Phoebastria palpebrata* (Archaux, 1999). Black-Footed and Laysan albatrosses are located in the mean range of an adult survival estimated to around 0.93. This high survival is correlated with a low fecundity (single egg clutch and intermittent breeding). This strategy strongly increases the impact of anthropogenic perturbation. The literature has been reviewed and the estimates gathered. Comparative analyses taking into account allometric effects and phylogenetic constraints will be done in the near future.
- Training: participation of Sophie Véran and Vivian Hénaux (thesis students) in a workshop on capture-recapture analysis (advanced level) (see Appendix 1)

b) A Leslie matrix model

- Most bird species, and albatrosses are no exception, show seasonal reproduction, and a strong variation of demographic characteristics with age. The Leslie matrix model is then a natural tool to describe the population dynamics of the species (Caswell 2000). A matrix equation gives the vector of numbers at time $t+1$ $x(t+1)$ as a matrix transform $M x(t)$, where M depends on the demographic parameters. Up to now we built a specific model to examine the cost of pair formation after widowhood and Allee effect (inverse density-dependence induced by shortage of partner availability at low densities) in Albatross populations, and examined in a preliminary way the effect of demographic stochasticity. An example of trajectories from the existing model incorporating demographic stochasticity is given below.
- Training: participation of SV et VH in a doctoral level course on population models (15 hours, matrix model formulation; estimation of eigenvalues and eigenvectors; perturbation analysis of population growth rate and notion of sensibility/sensitivity; age-classified matrix models and generalization to multi-stage matrix models; density dependence regulation; random environment matrix models; evolutionary stable strategy; dynamical and statistical models for exploited populations)

c) Contacts

At the present stage, it is too early to draw an extensive list of the pieces of information available to be combined, but a minimum will be capture-recapture information (both for survival and recruitment; possibly several distinct data sets obtained from monitoring of different colonies), census information, and by-catch information. Preliminary contacts have been established with people having responsibility for the various potential sources of data.

The main sources of data presently identified (see also Cousins and Cooper 1999) are:

- census of the number of breeding pairs by:
 - Direct counts of active nests immediately after laying has finished, on Midway Atoll since 1991, on Laysan Island since 1996 and on French Frigate Shoals since 1979. Those three main colonies represents almost 77 % of Black-footed and Laysan albatrosses populations.
 - Indirect counts in others breeding locality of the northwestern Hawaiian Islands: an extrapolation to total eggs from chicks counted between February and July and assuming a 75% of breeding success.
- Census to estimate the size of non-breeding population: a saturation banding and band-reading project is conducted at Tern island by the FWS. All chicks have been banding since 1979, and all unbanded adults have been banded since 1997.
- By-catch data from different longline fisheries with a monitoring program coordinated by the National Marine Fisheries Service: for groundfish longline fishery since 1990, for Hawaiian pelagic longline fishery since 1994. For other high-seas pelagic longline fisheries, there are no monitoring programs neither data of average annual take of albatrosses. As only a portion of the total fishing effort is observed, the total by catch may have to be extrapolated based on guess-timates on the portion of effort observed.
- Resightings data, presently being analyzed by J.D. Nichols and his group.

A list of contacts is given in Appendix 2.

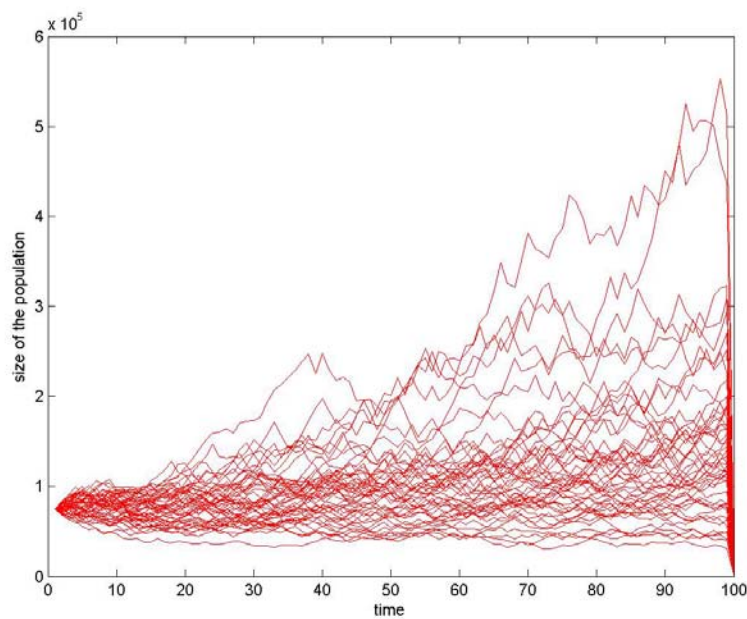


Figure 1: Projection of size of female population of Black-Footed albatross under environmental and demographic stochasticity.

d) Discussion

The two main difficulties up to now have been the delay in the finalization of the resighting data base and the availability of resightings analyses that have been delayed and will be available very soon, and the fact that the subcontract with CNRS in Montpellier has not yet been signed. In this preliminary step, we nevertheless solved a number of issues such as contacts and training.

References

- Archaud, F. (1999). Le syndrome de longévité chez les Procellariiformes. **DEA Université Montpellier II.**
- Caswell, H. (2001). **Matrix population models** (second edition). Sunderland, Mass., Sinauer.
- Cousins, K., and Cooper, J. (1999). The population biology of the Black Footed albatross in relation to mortality caused by longline fishing. **Report of the west. Pac . Regional Fish. Manag. Council.**
- Croxall, J.P. (1998). Research and conservation: a future for albatrosses? **Albatross biology and conservation** (G. Robertson and R. Gales, Eds.), Surrey Beatty and Sons, Chipping Norton. 267-288.
- Weimerskirch, H., Brothers, N., and Jouventin, P. (1997). Population dynamics of wandering albatross *Diomedea exulans* and Amsterdam albatross *D. amsterdamensis* in the indian ocean and their relationships with longline fisheries: conservations implications. **Biological conservation**, **75**, 257-270.

3. Plans for the next fiscal year.

- Finalization of demographic parameter estimation
- Full development of Leslie matrix model
- Training on model integration and first steps for integration

4. List of papers published in refereed journals during FY 2003.

None

5. Other papers, technical reports, meeting presentations, etc.

None

6. Names of students graduating with MS or Ph.D. degrees during FY 2003. Include title of thesis or dissertation.

Two thesis students in first thesis year : Sophie Véran, and Viviane Hénaux. Thesis defense planned for fall 2005

7. For multi-year projects, provide budget for the next year on a separate page.

Appendix 1:

WORKSHOP PROGRAM
from 24 to 28 March, 2003

Monday March 24 18:00-19:00 19:00-21:00	Arrival, registration of participants C.E.F.E. /C.N.R.S. Opening address, introducing each other Informal gathering.
Tuesday March 25 8:30-9:00 9:00-10:00 10:00-10:30 10:30-11:15 11:15-12:00 12:00-13:00 14:00-14:30 14:30-15:30 15:30-16:00 16:00-17:00	BASES 1: Introduction, multistate and single state recapture data, biological questions (JDL) BASES 2: The time-dependent Cormack-Jolly-Seber model (EC) <p style="text-align: center;">Coffee break</p> BASES 3: Time-dependent multistate models (JDL) BASES 4: Introduction to M-SURGE (RP & RC) EXERCISE 1: Time-dependent models, Canada Goose BASES 5: multistate models with constant parameters (JDL) BASES 6 : GEMACO, an introduction (JDL & RC) <i>Break</i> EXERCISE 2 & 3: Dipper & Constant parameter models, Canada Goose
Wednesday March 26 8:30-9:15 9:15-10:00 10:00-10:30 10:30-11:30 11:30-12:15 12:15-13:00 14:00-15:30 15:30-16:00 16:00-17:00	BASES 7: models for several groups, equality constraints, covariates (RP) BASES 8: several groups, additive models, part 1 (EC) <p style="text-align: center;">Coffee break</p> BASES 8: several groups, additive models, part 2 (EC) ADVANCED 1: GEMACO, advanced (JDL & RC) EXERCISE 4 & 5 : Swift & Rock Sparrow ADVANCED 2: Goodness-of-fit, part 1 & 2 (RP) <i>Break</i> EXERCISE 6 & 7 principles of Goodness-of-fit (Dipper, Canada Goose)
Thursday March 27 8:30-9:00 9:00-10:00 10:00-10:30 10:30-11:30 11:30-12:30 12:30-13:00 14:00-15:00 15:00-15:30 15:30-16:00 16:00-17:00	ADVANCED 3: Numerical & Statistical issues (OG) EXERCISE 8: Identifiability, Canada Goose <p style="text-align: center;">Coffee break</p> SPECIAL CASE 1: mixtures of events (JDL) EXERCISE 9: recoveries only and mixture of recoveries and recaptures SPECIAL CASE 2 : recruitment models (RP) EXERCISE 10: Flamingo OVERVIEW (JDL) <p style="text-align: center;">Break</p> Practical work on the participants' data
Friday March 28 8:30-10:00 10:00-10:30 10:30-13:00 14:00-14:30 14:30-16:00	Practical work on the participants' data <p style="text-align: center;">Coffee break</p> Practical work on the participants' data Practical work on the participants' data Presentation of these analyses, questions and summary of main points.

Appendix 2: Contacts (in bold : contacts established since initiation of work)

Name	E-mail	Organism	Role
Elisabeth Flint	Beth_Flint@r1.fws.gov	FWS Honolulu	Census data
David Hyrenbach	Khyrenba@earthlink.net	PRBO, CA	Ecotoxicology
Diann Gardiner	DLG@pcmail.nerc-bas.ac.uk	NERC= National Env Res Council	British expert on albatross
Ed Melvin	Emelvin@u.washington.edu	Univ Washington (State)	by-catch data
Greg Balogh	Greg_Balogh@fws.gov	Anchorage Alaska	CHAIRMAN ALBATROSS GROUP
Hal Caswell	Hcaswell@whoi.edu	Wood Hole Oceanographic Institute	Matrix models, Albatros models
James D Nichols	jim_nichols@usgs.gov	USGS PATUXENT (banlieue Washington DC)	Capture-recapture analyses
Katherine Hopper-Cousins (Mrs)	[KathyLHopper@msn.com]	Previously in charge of by-catch data	Cf report Cooper Cousins
Marti Mccracken (Mrs)	Marti.Mccracken@noaa.gov	Noaa, Honolulu	By-catch estimates
Rebecca Lewison	beccalew@duke.edu	Duke Univ NC	Postdoc on modeling
Rosemary Gales	Rosemary.Gales@dpiwe.tas.gov.au	Australia	Australian expert on albatross
Bill Kendall	William Kendall [W_Kendall@msn.com]	USGS, Patuxent	Resighting data, capture-recapture models
John Croxall	jpcr@bas.ac.uk	British Antarctic Survey	British expert on albatross
Pierre Jouventin	Jouventin@cefe.cnrs-mop.fr	CEFE-CNRS, France	French expert on albatross
Henri Weimerskirch	henriw@cebc.cnrs.fr	CEBC-CNRS, France	French expert on albatross