



**1st South American Workshop
on Aquatic Mammal Abundance Estimation Methods**
Laboratório de Estatística/DMT/ FURG
Museu Oceanográfico “Prof. Eliézer de Carvalho Rios”/ FURG
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FINAL REPORT
by
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Lecturers:

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Dr. Cibele Queiroz da Silva (UFMG – Belo Horizonte – BRA)
Dr. Enrique A. Crespo (CENPAT/UNPSBJ – Puerto Madryn – ARG)
Dr. Fernanda F. C. Marques (FURG – Rio Grande – BRA)
Dr. Paul Gerhard Kinas (FURG – Rio Grande – BRA)
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Hosted by: Laboratory of Statistics/DMT/FURG (Fundação Universidade de Rio Grande, Rio Grande, Brazil)

Endorsement by the Latin American Society for Aquatic Mammals (SOLAMAC) and the Cetacean Specialist Group (SSC/IUCN)

General Objective

Promote training of Latin American scientists dedicated to the study of aquatic mammals through lectures, discussions of sampling design and abundance estimation methods, and exchange of ideas and experience among colleagues working in the region.

Specific Objectives

- Presentation and discussion of participants' own survey design;
- Discussion of logistical problems inherent to the participants' study areas with recommendations for improvement in the estimation procedures;
- Discussion of problems of parameter estimation for the participants' own databases;

Significance

The 2002-2010 IUCN/ CSG Action Plan for Cetacean Conservation recommends that the estimation of abundance be a priority for the management and conservation of cetacean species in Latin America. This recommendation can also be extended to other aquatic mammal species such as pinnipeds and sirenians.

In order to assess the magnitude of the impacts of human activities on aquatic mammals, there is a need for accurate and precise estimates of abundance. Mortality must be put in the context of population size in order to evaluate the status of populations. Long-term series of abundance

estimates are needed to evaluate trends in populations affected not only by fisheries, but also by habitat degradation, noise pollution, vessel traffic or any other source of human-induced stress.

The high diversity of habitats in Latin America includes, for example, the Amazon and Orinoco River basins with freshwater dolphins and manatees, the broad coastal or pelagic areas in tropical or temperate marine ecosystems inhabited by pinnipeds and cetaceans, and the Fuegian channel region with its complicated topography (fjords, channels etc.). Species or stocks that require urgent attention occur in many regions. For example, the franciscana (*Pontoporia blainvillei*) and the South American estuarine dolphin *Sotalia fluviatilis* both inhabit the most populated coastal regions in South America. For these species, incidental mortality in fishing gear is a major problem and the discharges of human wastes and industrial pollutants are of increasing concern. Along the southern tip of South America, species such as Peale's dolphin (*Lagenorhynchus australis*), the Chilean dolphin (*Cephalorhynchus eutropia*), Commerson's dolphin (*Cephalorhynchus commersonii*) and Burmeister's porpoise (*Phocoena spinipinnis*) require abundance estimates to support status assessment. Dusky dolphin (*Lagenorhynchus obscurus*) populations also need to be estimated on both the Pacific and Atlantic coasts, where they are subject to various anthropogenic threats.

In most of cases, the links between local populations and the metapopulation are unknown and even where estimates of abundance are available at a regional scale, the dynamics of the population at a small spatial scale are ignored. It is necessary to think about strategies of estimation that take these kinds of problems into account. A general framework is needed to integrate abundance information at different spatial scales.

Even though the training of Latin American scientists has improved rapidly over the last decade, especially in some South American countries, few aquatic mammal specialists are sufficiently trained in the most advanced techniques of abundance estimation. The training of local experts in survey design and analytical procedures is minimal in vast regions.

Given this background, there was an urgent need for the proposed workshop in order to provide training to local scientists and technicians in abundance estimation methodologies. The workshop was intended to focus on the real needs of Latin American countries and the agenda explicitly addressed regional problems.

Eligibility criteria for participants

In view of the available space and computers, the number of invited participants was limited to 20. The participants were selected according to the following criteria:

- Participates actively in an aquatic mammal research program;
- Has estimated abundance by means of distance sampling or capture-recapture techniques;
- Needs assistance in survey design or data analysis;
- Possesses basic knowledge in distance sampling or capture-recapture models and is familiar with programs DISTANCE, CAPTURE, MARK or similar.

Candidates interested in the workshop were invited to submit by e-mail to organizers a proposal up to 4 pages long, identifying their study area, target species, research question and research methods. A Curriculum Vitae of the candidate (up to 3 pages long) was requested along with the proposal. Both the proposal and the CV were evaluated by the workshop's coordinators and training group. Participants were notified of their acceptance on 31 May 2003.

Official languages: Spanish and Portuguese

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Dynamics of the workshop

Participants were suggested to become familiar with the following literature before the workshop:

- 1) The chapter *Abundance Estimation* by Steve Buckland and Anne York. Encyclopedia of Marine Mammals;
- 2) Chapters 1 and 2, *Introduction to Distance Sampling* (by Buckland et al. 2001, or alternatively Buckland et al. 1993). (available at: http://www.cnr.colostate.edu/class_info/fw663/);
- 3) Thomas et al (2002), Encyclopedia of Environmetrics. (available at: http://dolphin.mcs.st-and.ac.uk/distancebook/dist_encyc_env.pdf);
- 4) Chapters 1 and 2, *Capture-Recapture and Removal Methods for Sampling Closed Populations* (White et al. 1982). (available as 'Source Material' at: http://www.cnr.colostate.edu/class_info/fw663/);
- 5) Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs 107. 97pp;
- 6) Otis, D. L., K. P. Burnham, G. C. White, and D. R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monograph 62. 135pp.

The workshop was introduced with lectures about general statistical concepts and abundance estimation methods in order to provide to all participants with a basic knowledge of sampling theory and likelihood estimation methods. The subsequent contents of the workshop were then divided into the two main areas: capture-recapture and distance sampling methods. Each subject was presented by means of lectures in which theory and examples were presented with the aid of available software.

After the pertinent theoretical and practical subjects had been reviewed, selected participants gave presentations of their current work and research questions associated with estimation methods and procedures. These presentations covered sampling design issues, logistics available for fieldwork and problems with data analysis and parameter estimation. Presentations were followed by a general discussion, comments and recommendations by the lecturers and other participants.

A combination of lectures and project discussions was seen by the organizers as a balanced approach to improve the participants' ability to design their surveys and analyze their data. The organizers believed that a interaction between trainers and participants through project discussions would be more productive than just lectures like the ones offered in a regular course.

Workshop Contents

A total of 72 hours were dedicated to the following subjects:

1. General concepts of statistical inference
2. Introduction to capture-recapture models (CR)
3. CR theory for closed populations
4. Software CAPTURE
5. Selection between models and model averaging
6. Jolly-Seber models
7. Pollock's Robust Design
8. Software JOLLY
9. Experimental design in CR
10. Software MARK
11. Introduction to distance sampling
12. Data collection: a field work activity with pellets
13. Distance sampling theory
14. Software DISTANCE use with field data
15. Practical aspects of marine mammal data collection in aerial and ship surveys
16. Stratification, covariables, Horvitz-Thompson estimator
17. Sampling design for distance sampling
18. Estimation of $g(0)$
19. Spatial and temporal modelling and platforms of opportunity
20. Introduction to Bayesian modelling and future perspectives

Results of the workshop

A final evaluation was carried out after completion of the ten days of the workshop. All participants concluded that it had exceeded their expectations and achieved the proposed objectives. They also agreed that their knowledge of statistical theory, capture-recapture and distance sampling methods had been substantially improved. The workshop is expected to immediately increase the participants' abilities to design field studies, and to use the appropriate logistics and analyses. In the medium-term, this will be reflected in the quality of their publications.

All participants agreed emphatically that more workshops of this kind should be held in order to continue with the development and training of human resources in Latin America. The following topics were proposed as priorities in this regard:

- (i) To expand the theory on more recent issues of capture-recapture and distance sampling methods, particularly the use of covariables in order to obtain better estimates of capture probabilities (CR) and the detection function (line transect), and to improve training in the utilization of softwares MARK e R);
- (ii) To include new subjects:
 - a. GIS,
 - b. Population Dynamics in Aquatic Mammals,
 - c. Decision Analysis.

An e-mail discussion list was created in order to encourage the exchange of information and questions among participants.

List of Participants

Participant	Degree	Institutional affiliation
Anne-Catherine Lescrauwaet (Chile)	Master in Zoology	Universidad de Magallanes
Caterina Dimitriadis Pampin (Uruguay)	Bachelor in Biology	Universidad de Uruguay
Cristiane Cavalcante de Albuquerque Martins (Brazil)	Master in Ecology	Instituto Baleia Jubarte
Daniel Danilewicz (Brazil)	Master in Biosciences (Zoology)	Grupo de Estudos de Mamíferos Aquáticos do Rio Grande do Sul (GEMARS)
Fernando Trujillo González (Colombia)	PhD in Zoology	Instituto Amazónico de Investigaciones Científicas SINCHI
Flavia Conde Kneip (Brazil)	Bachelor in Oceanology	Laboratório de Estatística – FURG
Gislaine de Fatima Filla (Brazil)	Master in Zoology	Universidade Federal do Paraná
Ignacio Benites Moreno (Brazil)	Master in Biosciences (Zoology)	Grupo de Estudos de Mamíferos Aquáticos do Rio Grande do Sul (GEMARS)
João Carlos Gomes Borges (Brazil)	Veterinarian	Centro Nacional de Pesquisa, Conservação e Manejo de Mamíferos Aquáticos/IBAMA-FMA
Leonardo Flach (Brazil)	Master in Ecology, Conservation and Management of Wildlife	UFMG
Lucas Baptista Hassel Mendes (Brazil)	Bachelor in Marine Biology	Projeto Baleias e Golfinhos de Arraial do Cabo
Maria Florência Grandi (Argentina)	Degree in Biology	Centro Nacional Patagónico - CONICET
Mariana Piedra Puig (Uruguay)	Bachelor in Marine Biology	Universidad de la República
Mariano Alberto Coscarella (Argentina)	Ph.D. Candidate	Universidad de Buenos Aires
Pablo Bordino (Argentina)	Master in Coastal Management	AquaMarina – CECIM
Paula Laporta (Uruguay)	Bachelor in Biology	Universidad de Uruguay
Paulo A. C. Flores (Brazil)	Ph.D. in Biosciences (Zoology)	I.W.C. – Brazil
Paulo Mattos (Brazil)	Bachelor in Biological Sciences	Museu Oceanográfico - FURG
Pedro Fruet (Brazil)	Academic in Biology	Unisinos
Raquel da Fontoura Nicolette (Brazil)	Specialist in Mathematics	Laboratório de Estatística – FURG
Rodrigo Hucke Gaete (Chile)	Ph.D. Candidate	Universidad Austral de Chile
Silvana Laura Dans (Argentina)	Ph.D. in Biological Sciences	UNPSJB e Centro Nacional Patagónico - CONICET
Yara da Rocha Camargo (Brazil)	Master in Tropical Biology and Natural Resources	Ecologia e Manejo do boto <i>Inia geoffrensis</i> na IHE Luís E. Magalhães, Lajeado, TO.