



Report to the Shackleton Scholarship Fund

1. Taxonomy of Shallow Marine Holothuroids
2. Management techniques, tools and processes for Natural Science Collections
3. Developing scientific links between the Falkland Islands and other international institutions

Scholarship recipient

Melanie Mackenzie
Marine Invertebrate Collection
Department of Science
Museum Victoria
Melbourne, Australia
mmackenzie@museum.vic.gov.au

Dates & Location

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*Live photo of the sea cucumber *Psolus charcoti* collected on the SMSG expedition to South Georgia.
Photo: Shallow Marine Survey Group*

Acknowledgements:

I am extremely grateful to all who supported me during my month in the Falkland Islands. In particular I am grateful to the Shackleton Scholarship Fund for their grant of £2,000 which covered the greater part of my flight here, to Paul Brickle and Paul Brewin for providing me with accommodation, office & lab space and internet and microscope access between South Atlantic Environmental Research Institute (SAERI) and the FIG Department of Natural Resources, and to my employer Museum Victoria for allowing me to work on secondment in Stanley for a month.

I thank the Shallow Marine Surveys Group (SMSG) for permitting me to study their fantastic collection of holothuroids from the Falkland Islands and South Georgia, and for taking me on a local collecting trip to observe collection techniques and methods used.

I thank the following groups and individuals for advice and assistance on CITES-related enquiries: Falkland Islands Customs & Quarantine officers, FIG Environment Officer - Nick Rendell, and Francine Nicholls of the AHVLA in the UK.

Thank you to James Fenton, Farrah Peck, Sarah Crofts and all at Falklands Conservation, Steve Massam and Leona Roberts at the Falkland Islands Museum and National Trust, Vlad Laptikhovsky for his help with octopus requests, everyone at SAERI, Fisheries, and SMSG, Katherin (Frin) Ross at South Georgia, Mike Butcher, Paul Howes, the Rendell family and others in the community for putting up with my constant questions and requests regarding invertebrate, fish, and mammal specimens, freshwater and marine surveys, collection, preservation, conservation and taxidermy. Thank you to Alicky Davey and Jonathan Handley at Falklands Conservation for allowing me to briefly assist with seed-collection and gentoo penguin research, and to Phyll and Mike Rendell on Bleaker Island and Derek and Trudi Pettersson at Volunteer Point for their generous hospitality during this fieldwork. Thanks to my colleagues back at Museum Victoria for sending through information as specific requests/questions came up, and in particular Antarctic holothuroid expert Mark O'Loughlin for ongoing collaborative taxonomic work.

And last but not least, a huge thank-you to the wonderful people of the Falkland Islands for their friendship, hospitality and enthusiasm during my month here. I felt privileged to witness the historic Referendum week and the phenomenal display of national pride and community spirit that came with it. I can't speak more highly of the Falklands as a great place to visit and a thriving destination for scientific and environmental research.



Museum Victoria, Melbourne, Australia. Photo: M.Mackenzie – Museum Victoria

1) Taxonomy of Shallow Marine Holothuroids (sea cucumbers)

Goal:

To gain a better understanding of holothuroid (sea cucumber) biogeography in the region by examining and identifying shallow marine material collected from South Georgia, the Falkland Islands and surrounding waters. To make recommendations regarding “voucher” material for the reference collection, and depending on time and accessibility, also assess and identify Ascension Island material.

Collecting Methods [SMSG/Fisheries]:

In late 2010 the Shallow Marine Survey Group (SMSG) completed a shallow benthic survey along the north coast of South Georgia between Bird Island in the north-west and Cooper Bay in the south-east, examining intertidal habitats and also using scuba to explore the sub-tidal environment down to 18 meters. The work was the most comprehensive scientific survey of its kind in the area since the *Discovery* expeditions of 1925, and was part of a larger Darwin Initiative project in partnership with the British Antarctic Survey (BAS) and the South Georgia Government. Many marine invertebrate samples were collected for examination and identification including a number of holothuroids which were fixed in ethanol or similar preservatives for later studies and kept in storage in the FiPass collection store awaiting identification.

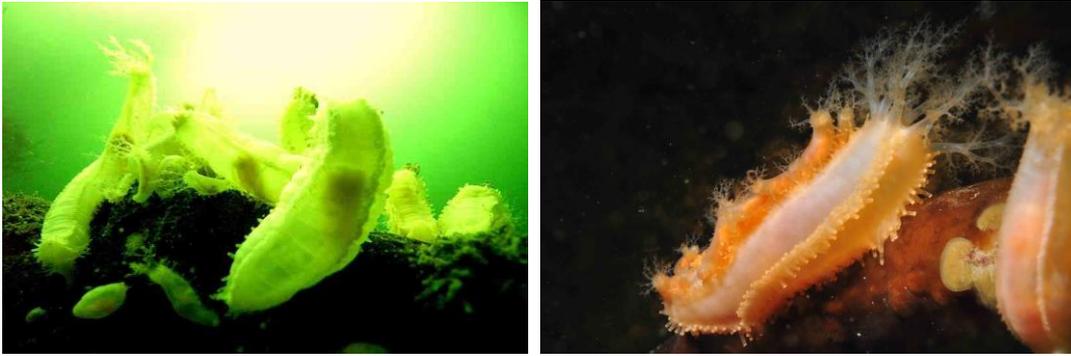


The SMSG South Georgia team: Dr Paul Brewin, Dr Emma Wells, Steve Brown, Dr Paul Brickle, Dion Poncet, Steve Cartwright, Dr Judith Brown and Dr Claire Goodwin. Photo: Shallow Marine Survey Group

Additional holothuroid material has been collected on various surveys of the Falkland Islands including the Fisheries Icon Survey and ongoing SMSG surveys.



SMSG divers on a sub-tidal survey of Yorke Bay, March 2013. Photo: M. Mackenzie – Museum Victoria



Cladodactyla crocea (Lesson, 1830) – the ‘Saffron Sea cucumber’ is seasonally quite common in Falklands waters and can even be seen carrying juveniles on its back (right). Photos: Shallow Marine Survey Group

Examination Methods:

Material from these surveys was transferred from temporary storage at FiPass to the Fisheries Department where holothuroids were separated from mixed lots and examined in detail. Taxonomic identification by morphological methods involved examination and measurement of external/internal characteristics along with a closer look at specimen ossicles (remnant skeletal elements in the skin of sea cucumbers). Ossicles were examined under a compound microscope by first taking a small section of tissue and mounting this on a slide, then using bleach to dissolve the skin, leaving behind the calcified structures which vary to different degrees in different parts of each animal and between species. Photographs of specimens and ossicles were also taken where possible for ongoing analysis.



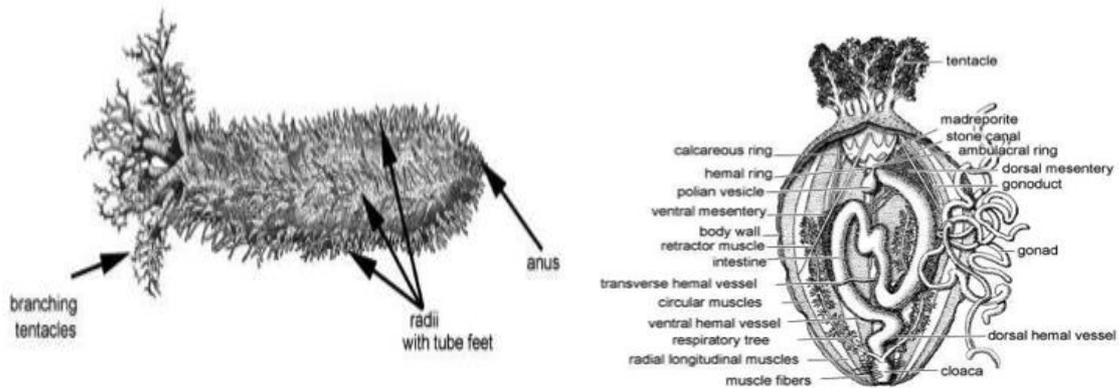
Tools of the trade - Bleach, a dissection kit, and stereo and compound microscopes are the chief necessities for morphological identification of sea cucumbers. Photos: M.Mackenzie – Museum Victoria



Working in the lab at the Falkland Island Fisheries/Agricultural Department. Photo: P. Brewin

External/Internal Characteristics

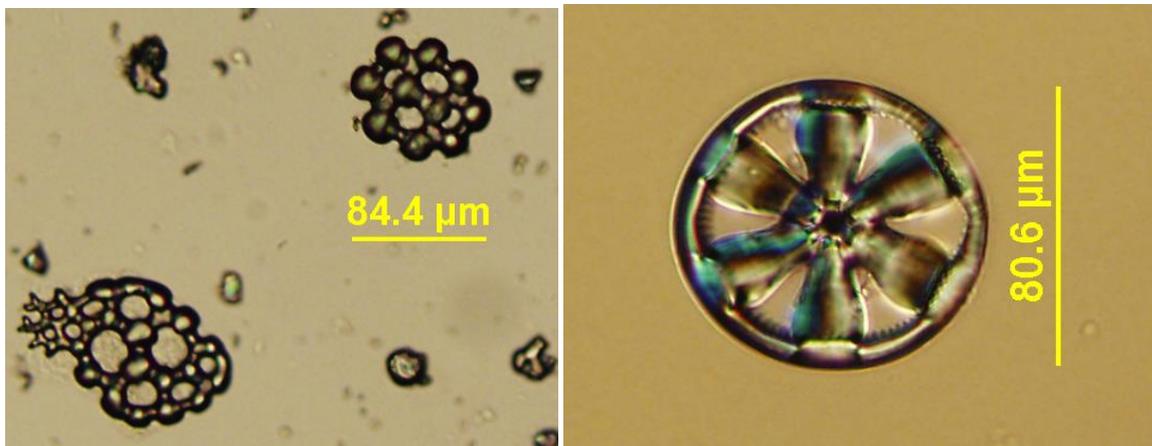
Tentacle and tube-foot structure, number and arrangement are all important when identifying a sea cucumber, along with many other characteristics such as size, colour, texture, shape and internal morphology.



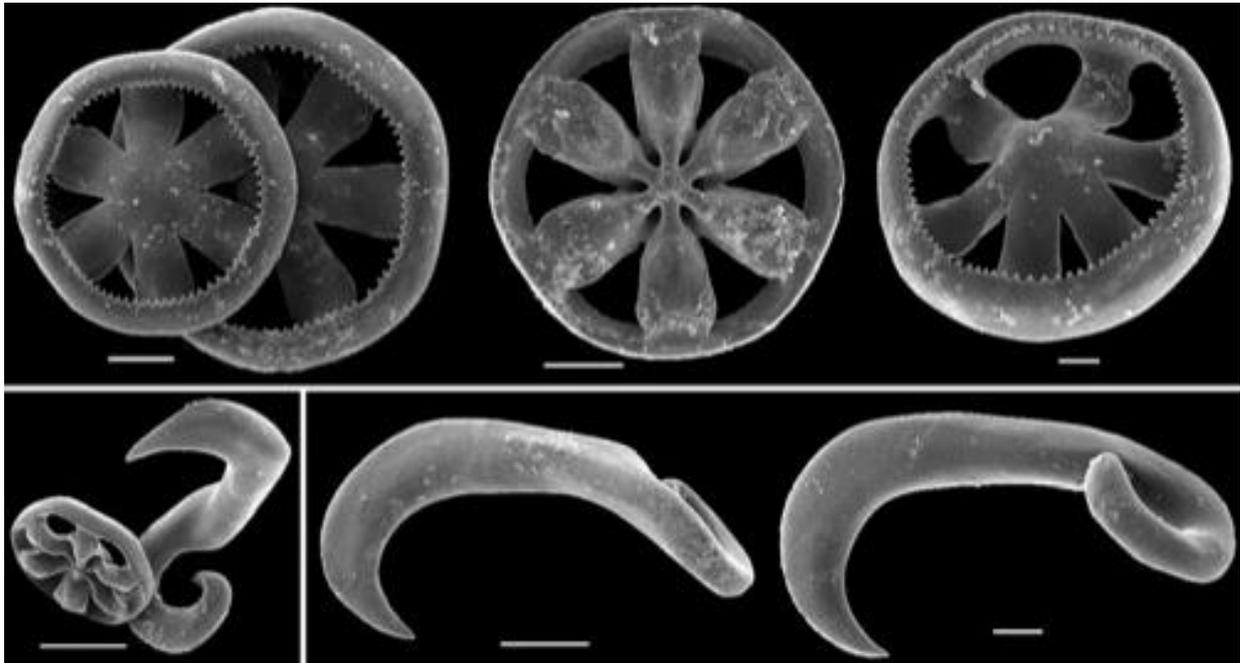
General morphology of a dendrochirotid sea-cucumber. Illustration: From Pawson, D.L. & Pawson, D.J – Smithsonian Institution, *An Illustrated key to the sea cucumbers of the South Atlantic Bight*, prepared by Rachel King - Southeastern Regional Taxonomic Centre, 2008

Ossicles

These can take the shape of perforated plate structures, crosses, cups, anchors, wheels, hooks and many other forms. Often they help to give the animal its texture or appearance, for example an animal with multilayered plates with spires might actually have a prickly body wall, while one with anchors may be sticky to the touch. Ossicles are rarely visible to the naked eye, but if the body wall is translucent, or the ossicles 'stick out' they can sometimes be seen under a dissecting microscope. Usually though, they are best viewed with a compound microscope, mounted on a slide.



Ossicles come in all shapes and sizes, from the knobbed, perforated plates and buttons of Falkland Island species *Pseudocnus leoninus*, to perfectly shaped 'wheels' of the South Georgia species – *Sigmodota contorta*. Photo: M.Mackenzie – Museum Victoria



Ossicle structures look even more impressive in 3D, as in these sampled from an earlier 'Discovery' holothuroid from South Georgia. SEM photo: Didier VandenSpiegel, in O'Loughlin & VandenSpiegel, 2010

Results:

This visit to the Falklands has helped to clarify overall understanding of the marine benthos in the area and paving the way for comparison between this current work and relevant specimens from the 1925 *Discovery* expedition and other collections previously identified by our holothuroid team at Museum Victoria. This fits well with the SAERI-initiated (Darwin sponsored) project of uploading collection data from the *Discovery* reports which will make data readily accessible for comparison.

Over 100 specimens were studied and all material separated, re-housed and labeled as required. Specimens were coded and labeled with temporary registration numbers and locality details, with a full complement of specimen and collection data now being prepared for entry into the permanent collection database system. Photos were taken where time allowed, and voucher specimens for the permanent reference collection have been preliminarily selected, with others noted as available for future donation to other international institutions where ongoing scientific research can be conducted.



Falkland Island specimens being prepared for examination, photography and permanent collection storage. Photo: M.Mackenzie – Museum Victoria

Two orders of Holothruoidea (Dendrochirotida and Apodida) were evident in the 100+ samples and from these at least 9 genera and 10 different species were identified, including the species below:

Order: Apodida **Family:** Chiridotidae
Sigmodota contorta (Ludwig, 1875)

Order: Dendrochirotida **Family:** Cucumariidae
Cladodactyla crocea (Lesson, 1830) Panning 1949
Cucumaria georgiana "group"
Heterocucumis steineni (Ludwig, 1898)
Pseudocnus leoninus (Semper, 1867)
Pseudocnus perrieri (Ekman, 1927)
Psolicrux coatsi (Vaney, 1908)
Trachythyone bouvetensis (Ludwig & Heding, 1935)

Order: Dendrochirotida **Family:** Psolidae
Psolidium incubans Ekman, 1925
Psolus charcoti Vaney, 1906

Additional species still to be confirmed include *Taeniogyrus antarcticus* Heding, 1931, *Cucumaria dudexa* O'Loughlin & Manjón-Cabeza, 2009, *Psolus* & *Psolidium* species (including one or more potentially new species) and a 2 mm long apodid with a very surprising combination of ossicles normally restricted to two separate genera. Falkland Island specimens were restricted to *Pseudocnus leoninus* (Semper, 1867), *Cladodactyla crocea* (Lesson, 1830), and some psolid species, while the others listed above were from South Georgia.



Live image of *Pseudocnus leoninus* collected from Yorke Bay by the SMSG.
Photo: M. Mackenzie – Museum Victoria



A preserved psolid sea cucumber from the Falkland Island holothuroid collection showing body wall scales and oral valves covering tentacles. Photo: M. Mackenzie – Museum Victoria

While further collection and examination of material is required, the data collected so far is a valuable contribution to the overarching holothuroid story within the region. Of particular interest are the specimens potentially new to science and while some very preliminary intertidal scouting of Falkland Islands intertidal zones revealed no specimens, it is likely that a concerted search effort including collecting sub-tidal seaweed to sift for smaller specimens may reveal additional species.

Future Outcomes expected:

The addition of all new taxonomic data to the permanent catalogue record will allow the data, images and specimens themselves to be loaned or donated to other institutions. Voucher specimens will be selected for each species to assist with future identification work, and SAERI will retain these specimens along with virtual records of all material. The data from this project will feed into SAERI/SMSG records for South Georgia and the Falkland Islands, and contribute to research papers on the region, with potentially new species to be described in taxonomic publications, live and preserved images to enhance other publications, and ongoing work regarding biodiversity and links between Antarctic, sub-Antarctic, Falkland and Magellanic material. SEM photography and DNA sampling may also be viable with time and funding in the future as many of these specimens have been preserved in the optimal 95% ethanol.

2) Management techniques, tools and processes for Natural Science Collections

Goals:

- To provide assistance with development and implementation of an appropriate Collection Management strategy for biological research material held by institutions within the Falkland Islands, and in particular the material collected by the Shallow Marine Survey Group in association with the South Atlantic Environment Research Institute.
- To Initiate procedures for the South Atlantic Environmental Research Institute (SAERI) to gain scientific certification under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or related conventions
- To facilitate international loan and receipt of scientific specimens.

Methods:

Drawing on personal experience in collection management techniques and systems used at international institutions I was able to conduct a preliminary assessment of the marine collections in the Falkland Islands, consult with local and UK authorities regarding CITES regulation standards, discuss needs and resources with departments and interested parties and propose a strategy for implementation of 'best practice' methods for long-term management of the specimen collection. Discussions were preliminary only and consultation with further interested parties will be necessary before finalization and implementation of a suitable strategy.

Results & Recommendations:

- A draft proposal for the Falkland Islands Collection Management Strategy has been submitted to SAERI for further discussion with interested parties (e.g. Fisheries, Conservation, the SMSG and the Falkland Islands environment officer). A copy can be supplied to the *Shackleton Scholarship Fund* upon request. As a brief overview the proposal includes:
 - Implementation of a registration system and permanent 'database' for all specimens
 - Standardisation of 'best practice' methods for handling and storage of specimens (including Occupational Health & Safety considerations, use of appropriate storage containers and labels, appropriate use of fixation, preservation and storage fluids)
 - Discussion and implementation of an appropriate storage organization (e.g. Linnaean system as in international institutions)
 - Application to the world CITES register to be accepted as valid institution for specimen exchange (and guidelines and draft proposal for meeting the standard required)
 - Implementation of appropriate transaction procedures for exchange of specimens as loans and donations including procedures, database requirements and template forms
- A draft submission for CITES application was prepared and submitted to SAERI for further discussion. The desired outcome of the proposed collection storage upgrade and CITES submission is that SAERI become the local CITES registered body for facilitated scientific exchange between the Falkland Islands and other international institutions.
- A draft manual was also submitted to SAERI for further discussion with interested parties. A copy can also be supplied to the *Shackleton Scholarship Fund* upon request. As an overview, contents include:
 - The Specimen Collection – an overview
 - The Specimen Database – an overview
 - Surveys & Expeditions - field collection
 - Labeling - Specimens & Images
 - New Accession Lots - Identification and Rationalization
 - Registration & Permanent Storage
 - Collection Access Policy Overview
 - Collection Transactions – Processes, Documents & Postage
 - Maintaining CITES Compliance

- Managing Missing Collection Items

Manual appendices include checklists, sample templates & forms for the following:

- Catalogue Record overview (specimen database)
 - Risk Assessment & Collection Incident Reports
 - Specimen labels
 - Deed of Gift forms for Donation
 - Collection Access Requests
 - Collection Induction (checklist & logbook)
 - Collection Transactions – specimen & tissue loan, donation & exchange forms
 - Manufacturer’s Declaration, notes to Customs & Quarantine & Address labels for posting specimens
 - Image Use agreements
 - Facilitated Scientific Exchange Log
- A folder of other useful resources including links to online resources, citizen science collaborative projects, and Collection Documents & Information was provided (e.g. Collection Equipment & Suppliers, Government documents & Policy, Literature/Further reading for collection Preservation & Storage, sample bulk upload template for specimen data, Field Guide App links, and identification keys & toolkits).



The Marine Invertebrate Collection at Museum Victoria (Australia), with specimens arranged taxonomically on shelves and oversized items (such as giant squids) housed in specialized tanks.

Photo: Melanie Mackenzie – Museum Victoria

3) Developing scientific links between the Falkland Islands and other international institutions

Goal:

To promote exchange of specimens and knowledge with other international institutions via collection access (e.g. specimens, data and images). To develop strong links between scientific institutions and community-based groups in the Falkland Islands and the Museum of Victoria, with the desired aim of ongoing professional exchange of both scientific specimens and knowledge and community-based-science initiatives.

Current communication and future collaborations:

- See section 2 - 'Management techniques, tools and processes for Natural Science Collections' for proposals leading to facilitated scientific exchange of data and specimens including upgrading collection management and storage and promoting CITES registration for SAERI.
- See section 1 - 'Taxonomy of Shallow Marine Holothuroids' for ongoing collaboration between SAERI, SMSG, FI Fisheries and myself and Mark O'Loughlin at Museum Victoria and our international colleagues (including BAS) on holothuroid taxonomy and evolutionary studies within the region. It is likely that in the future this taxonomic work will also extend to Ascension Island sea cucumbers.
- While working in the Falkland Islands with SAERI and SMSG I was also able to do some volunteer work with Falklands Conservation and initiate communication between a number of scientific and community groups and my colleagues at Museum Victoria (see 'Acknowledgments' and below):

Marine mammal skeletons: Dr. Erich Fitzgerald is a Senior Curator of Vertebrate Palaeontology at Museum Victoria, with a particular interest in the evolutionary history of marine mammals such as seals, dolphins and whales. While Museum Victoria has a good collection of marine mammal skeletons, Erich was interested in 'filling the gaps' from species found closer to the Falkland Islands to assist with his ongoing research. In particular he was interested in photos or specimens (skulls and jaws) which could be donated or exchanged with Museum Victoria, including any from: the South American fur seal (*Arctocephalus australis*); South American sea lion (*Otaria flavescens*); Commerson's dolphin (*Cephalorhynchus commersonii*); dusky dolphin (*Lagenorhynchus obscurus*); Peale's dolphin (*Lagenorhynchus australis*); hourglass dolphin (*Lagenorhynchus cruciger*); southern right whale dolphin (*Lissodelphis peronii*); and the spectacled porpoise (*Phocoena dioptrica*). While no specimens were available for donation during my stay, many individuals and groups provided advice and assistance or allowed me to take photographs of their own collections including: Farrah Peck and Sarah Crofts at Falkland Islands Conservation, Steve Massam and Leona Roberts at the Falkland Islands Museum and National Trust, Joost Pompert and his fisheries observers at the Falkland Island Fisheries Department, the Rendell family at Bleaker Island and Mike Butcher. Environment Officer Nick Rendell has also provided paperwork so that if samples become available in the future the appropriate permits will allow for their donation to Museum Victoria, which will be further streamlined once SAERI achieve CITES registered institution status. More of Erich's work can be seen at the link below:

<http://museumvictoria.com.au/collections-research/sciences/palaeontology/people/erich-fitzgerald/>

Octopus taxonomy: Dr. Mark Norman is Head of Sciences at Museum Victoria, but while leading the large Natural Science research and collections teams maintains his own interest in cephalopod taxonomy, evolutionary and behavioral studies. Museum Victoria has a comprehensive collection of octopus, squid, cuttlefish and related specimens, thanks largely to a succession of cephalopod curators and collection managers including Dr. CC Lu (also of the National Taiwan University), Mark himself, Dr. Mandy Reid (now of the Australian Museum) and current curator Dr. Julian Finn. Mark expressed an interest in octopus species stored in the Falkland Islands collections or in future collections by SMSG and the Fisheries department. Vlad Laptikhovsky of the Falkland Island Fisheries department was able to provide a list of shallow water, upper shelf and deep water

species of octopus, including some descriptions and images. Vlad has also indicated a willingness to assist with collection of specimens should Museum Victoria be interested in further studies of these or other species.

More of Mark's work can be seen at the link below:

<http://museumvictoria.com.au/collections-research/sciences/marine-sciences/people/mark-d-norman/>

More of Julian's work can be seen at the link below:

<http://museumvictoria.com.au/collections-research/sciences/marine-sciences/people/julian-finn/>

Freshwater Ecosystems: Dr. Richard Marchant is a Senior Curator of Entomology at Museum Victoria with a particular research interest in freshwater river systems. Having studied these ecosystems on the sub-Antarctic Macquarie Island, he was interested in whether research was being carried out in the Falkland Islands or any sub-Antarctic islands in the vicinity. I had initiated contact between Dan Fowler and Richard Marchant the previous year but Richard was keen to hear of any further work being carried out. Catherine (Frin) Ross was able to give me a little background on work in South Georgia, while James Fenton at Falkland Islands Conservation provided some of his own observations for invertebrates observed in freshwater streams in the Falklands, along with those made by Dr. Roger Flower who surveyed the islands in 2001. Nick Rendell's 2011 'Biodiversity snapshot' for the Falkland Islands was also a useful resource to pass on. In general it seems that freshwater ecosystems in the vicinity have not been studied in great detail to date, and in particular information on freshwater invertebrates is quite limited, possibly due to an impoverished fauna.

More of Richard's work can be seen at the link below:

<http://museumvictoria.com.au/collections-research/sciences/terrestrial-environments/people/richard-marchant/>

Falkland Islands Conservation: I was accepted as a volunteer on two short conservation fieldtrips during my stay. I assisted Alicky Davey with seed-collection on Bleaker Island, contributing to the Kew Gardens Millennium Seed Bank Project and future regeneration work on the Falkland Islands. I also assisted Jonathan Handley with data and feather collection from Gentoo penguin colonies near Cow Bay for an isotope analysis project. Both trips gave me an insight into field collection techniques and the variety of environmental projects and habitats in the Falkland Islands, and I was also grateful to use the opportunity to see more of the local wildlife and scenery.

Biosecurity: During my stay on Bleaker Island, the FI Environment Officer Nick Rendell also gave me some insight into the impact of invasive species on the Falkland Islands, and in turn I was able to suggest some useful online taxonomic tools being used by biosecurity/quarantine groups in Australia, such as PaDIL (<http://www.padil.gov.au/>) which includes identification tools for invasive animals and plants.

Taxidermy: Steve Massam of the Falkland Islands Museum and National Trust also allowed me to film and photograph some of his taxidermy and preparation of mammal and bird mounts for display, including his current preparation of an Antarctic Emperor Penguin. The techniques used will be of interest to our mammal and bird departments where taxidermy & preparation work is often done in-house, and I have invited him to contact me for a back-of-house tour of our own collections should he come to Museum Victoria.

Community & Citizen Science: The Marine Research Group of the Field Naturalists Club of Victoria also donated a number of their field guide publications to SAERI and SMSG, and Reefwatch Victoria provided a sample dive-slate and identification kit for their citizen science 'great fish count' as examples of community involvement in marine science surveys. I have also passed on links to free field guide apps developed by Museum Victoria in collaboration with community and government groups, and citizen science portals such as BowerBird (<http://www.bowerbird.org.au/>).

Correspondence between Alexandra Mystikou, (a PhD candidate from the University of Aberdeen working with SAERI during my stay) and Val Stajsic from the National Herbarium of Victoria in the

Royal Botanic Gardens in Melbourne was initiated, and Val sent through a list of suggested preservation techniques for her seaweed projects. Others from Museum Victoria have also expressed a willingness to assist with taxonomic identification of particular groups (e.g. valviferous isopods) should SAERI or SMSG require assistance, and I have passed on information about the FI fisheries observer program to individuals at MV who have expressed interest, and Falkland Islands coins have also been submitted for donation to the MV coin collection.

I have been asked to give presentations on my work and time in the Falkland Islands to local community groups (e.g. the Marine Research Group, Field Naturalists Club of Victoria) along with the scientific community and public at Museum Victoria and look forward to doing these soon.



Steve Massam showing his current taxidermy and preparation of an Emperor Penguin, and a skull from the FI Museum collection. Photos: M. Mackenzie – Museum Victoria



Mike Butcher with his impressive collection of whale and marine mammal skeletons from the Falkland Islands. Photo: M. Mackenzie – Museum Victoria



*Above: Bleaker Island - Alicky Davey collecting seeds and Phyll and Nick Rendell scouting for plants for regeneration.
Below: Cow Bay near Volunteer Point – Gentoo penguin fieldwork with Jonathan Handley. Photos: Museum Victoria*

