IN READING THE narratives of historic seagoing expeditions, we came to realize that observations made by early naturalists provide usable data on relative abundance, size, and habitat, feeding behavior, and uses and trade by the local people, for a time depth not usually provided by other methods used in the study of biodiversity. We offer here an approach for recording and “scoring” these observations in a reproducible fashion, such that temporal trends in biodiversity can be inferred. This method can be employed by environmental historians to reach further into the past, especially in areas where reliable statistical data is missing, as is often the case with ocean issues. We chose to focus on the Falkland Islands for our case study, as these islands apparently were uninhabited when Europeans discovered them, and have since been a port of call for many vessels.

MATERIALS AND METHODS

OUR INITIAL BIBLIOGRAPHIC search identified more than five thousand records corresponding to a combination of these keywords: Falkland, expedition, survey, voyage, and natural history. However, only fifty were pertinent to our study, of which sixteen (3,700 pages) were available at the University of British Columbia library (see Table 1).

Accounts of marine organisms occurring in a specific locality were extracted and encoded into the historic expeditions and surveys database, a relational

abundant in poisons, la plupart peu connus."

When out on a whaler we had the good fortune to secure a fine

Examples of Anecdotes and the Codes Applied to Them.

<table>
<thead>
<tr>
<th>Anecdote</th>
<th>Functional Group</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;The island which M. de Bougainville set on fire, was at first called Penguin Island because these birds were found there in such numbers, that upwards of two hundred perished in the flames. There remained however, a prodigious quantity; and we found some of them at every step.&quot;</td>
<td>Seabirds</td>
<td>Extremely abundant</td>
</tr>
<tr>
<td>&quot;Toutes les côtes abondent en poissons, la plupart peu connus.&quot;</td>
<td>Fish</td>
<td>Abundant</td>
</tr>
<tr>
<td>&quot;Notothenia sima, Richards. Stanley Harbour. Very common.&quot;</td>
<td>Fish</td>
<td>Very common</td>
</tr>
<tr>
<td>&quot;On the hulks at the extremities of both the dockyard jetty and also the Falkland Island Company's west store, numbers of Trophon geversianus in the most perfect condition can be obtained.&quot;</td>
<td>Invertebrates</td>
<td>Common</td>
</tr>
<tr>
<td>&quot;... les beaux, chevaux, porcs et lapins importés par les Français et les Espagnoles s'y sont depuis considérablement multipliés à l'état sauvage. Au contraire les amphibies, qui étaient extrêmement nombreux, y ont été à peu près détruits par les pêcheurs anglais et américains.&quot;</td>
<td>Marine mammals</td>
<td>Rare</td>
</tr>
<tr>
<td>&quot;Here are no sea-tortoises, but many land ones.&quot;</td>
<td>Sea turtles</td>
<td>Absent</td>
</tr>
<tr>
<td>&quot;Once when out on a whaler we had the good fortune to secure a fine whale and while making it fast to the side of the steamer some dozens of these birds suddenly appeared round the ship.&quot;</td>
<td>Whales and seabirds</td>
<td>Occurs</td>
</tr>
</tbody>
</table>

Coding was based on words used in the descriptions indicating relative amounts of observed marine organisms (see Table 2). For example, “fish abound along the coast” was coded as abundant, while “enormous quantities of” was coded extremely abundant. Coding can be repeated independently by several researchers in order to reduce subjectivity.

Each anecdote was assigned to the functional group being described (marine mammals, seabirds, turtles, fish, invertebrates, seaweed, algae, others). Scientific names of the species, when mentioned or footnoted, and biological information (for instance, size, feeding and spawning behavior), were recorded. If the anecdote described several groups of species in one sentence, separate records were entered to account for each functional group mentioned, including the name of species when specified. Each anecdote was linked to the following information:

- the “sampling station”, that is, the coordinates, time of arrival and departure, the country, and local names of the “station”;
- the expedition details;
- the source and online links to the entire text, if available;
- the specimen accession number, if identified, and online links to the website of the museum that holds the specimen, if available.

The abundance anecdotes were separated by functional groups and arranged chronologically. Observations for each functional group were further subdivided into time periods with similar number of observations and plotted on the chronological axis at the value corresponding to the mean of the years with observations. The total number of observations per coding level was obtained for each time period (represented by its mean year). This permitted the plotting of
the "perceived" abundance (in percent; by coding level) of each functional group over time.

To test the plausibility of the resulting time series trends, estimates of extracted biomass or numbers of individuals killed were obtained from independent sources.19

RESULTS

DESCRIPTIVE NATURAL HISTORY

THE NARRATIVES INCLUDED in this study provided us with a view of the natural history of the Falkland Islands from the time of their sightings by the Spanish and Portuguese sailors and subsequent inclusion as "Insule 7 delle pulzelle," on the first map to bear the name of America by Martin Waldseemüller in 1507.20

Observations by privateering explorations, those of Captain John Davys of the Desire, or the second privateering expedition of Thomas Cavendish in 1591-1593, for instance, were cartographic and described how these ships replenished supplies, with scarce mention of the natural resources they encountered in these islands.21 Most of the earlier narratives mention that the Falklands were "barren," providing little or no wood and no access to freshwater. However, seabirds and seals were observed as "extremely abundant"—expectedly so since these animals are easily seen. Sebald de Weert, vice-admiral of a Dutch fleet on board the Blijde Boodschap, wrote: "They here saw vast numbers of those birds called 'pongeons' or divers, because they dive into the water to catch fish.22 They killed there ten or fourteen of them with sticks, and might have killed as many as would have served the whole fleet, but would not lose the opportunity of a fair wind."23 The Englishman William Dampier on board a buccaneer's ship in 1684, wrote that "January 28th we made the Isles of Sebald de Weert ... where we found foul rocky Ground, and the Islands barren, and destitute of trees, but some Dildo-bushes growing near the Sea-side. We saw the same day vast shoals of small red Lobsters, no bigger than one's Finger."24

The first recorded landing was not until January 28, 1690, when the British captain, John Strong, anchored at Bold Cove, Port Howard where he wrote that "this land doth show like a great many Islands ... there is several keys that lye along shore. Wee sent our boat on Shoar to one of them and they brought on board abundance of Pengwins and other fowl and Seals." Strong named the islands after the Viscount of Falkland, one of the owners of his ship, the Welfare.25 At the end of the seventeenth century, French seafarers, quietly establishing an extensive trade with South America, used the islands as their base. They called the islands Îles Malouines, after St. Malo, a city in northwestern France.26 French activity in the southern seas led to the establishment of a French colony at Port St. Louis (named after the ship St. Louis, commanded by Jacques Gouin de Beauchêne, which landed there in 1698).27 The colony was established in the East Falkland by Louise-Antoine Comte de Bougainville.28 Bougainville's stay (1763-1764) and successive voyages (1766) to the Falkland Islands provided not only detailed descriptions of aquatic and terrestrial life, but also of their abundance.29

The French relinquished the islands to the Spanish in 1767, and from then on the islands were known by the Spanish version of their French name, the Malvinas. In the early 1820s, a successful colony of "cowboys," the "gauchos," was exporting dried beef and salted fish to Brazil and wool to London.30 However, the British reclaimed the islands in the 1840s, renaming them the Falklands, and the population of gauchos was replaced by settlers from England.31 This era marks the beginning of the exploitation of terrestrial and aquatic resources, though American sealers had been harvesting the seal populations around the islands since the late 1700s.32

Charles Darwin's visits to the islands in 1833 aboard the Beagle and again in 1834 provided a rich collection of specimens along with notes, from Captain Robert Fitzroy, Syms Covington (Darwin's assistant) and Darwin himself, describing the islands' natural resources.33 Darwin at first found the islands "desolate," being "universally covered by a brown wiry grass, which grows on the peat ... & excepting snipes & rabbits, scarcely any animals."34 Covington, on the other hand, found "low Bushes with red berrys [sic] which are very good eating" and "enormous numbers of Bullocks Horses & Pigs ... Rabbits, wild geese & Ducks & ... most excellent Snipe Shooting in the Marshy ground & Long grass, which the Island in general is very little else."35 Darwin later on found that the islands were not desolate after all. They had "an immense quantity & number of kinds of organic beings which are intimately connected with the Kelp ... the infinite number of small fish which live amongst the leaves ... Crustacea of every order swarm, ... Encrusting Coralines & Aztias are excessively numerous ... The number of compound & simple Ascidia is a very observable fact ... Heurobranchus is common: but Trochus & petalliform shells abound on all leaves." Darwin believed that these islands will "become a very important halting place" with "fine harbors, plenty of fresh water & good beef."36 Darwin also expressed concern that, as the islands became colonized, certain rare, endemic, and exploited species (such as the Falkland fox—the "warrah") would "be ranked among those species which have perished from the face of the earth."37

TIME SERIES TRENDS OF PERCEIVED ABUNDANCE

OF THE MANY references available on voyages to the Falkland Islands, we limited our data gathering to the narratives in English and French available to us through the University of British Columbia Library. We screened seven thousand pages to identify 194 pages that contained useful anecdotes for marine organisms.

For these, we extracted about five hundred observations on terrestrial, aquatic, and marine organisms for the Falkland Islands from the various publications we examined from the 1590s to the 1920s. However, only 390 records were of marine organisms and of those only 353 were usable: marine mammals (15.9 percent), seabirds (14.2 percent), fish (5.7 percent), invertebrates (30 percent), algae and sea grass (5.9 percent). Occurrences of marine organisms, where no indication of abundance was mentioned, were inferred from 28.3 percent of these usable observations. The rest were observations for which no date and/or year was mentioned and thus not suitable for our methodology.
Figure 1. Perceived Abundances of Marine Organisms in Percent of Total Number of Observations per Chronological Group.

A: marine mammals, i.e., whales, dolphins and seals, n=56 from 7 narratives (2,639 pages of text perused) from 1690 to 1924. B: seabirds, mostly penguins, n=50 from 9 narratives (2,621 pages) from 1598 to 1911. C: fishes, mostly pelagics, n=20 from 9 narratives (2,090 pages) from 1696 to 1911. D: invertebrates, mostly mollusks, n=106 from 7 narratives (1,771 pages) from 1703 to 1988. E: algae and seagrasses, n=21 from 5 narratives (1,335 pages) from 1690 to 1911.

Of the five functional groups considered here, only marine mammals, seabirds, and invertebrates could be analyzed. The other groups were not as viable because of the paucity of records.

The plots of relative abundance over time showed that, for marine mammals and seabirds, the number of observations that classified organisms as "extremely abundant" and "abundant" decreased over time. Conversely, the number of observations that classified them as "rare" and "absent" increased (Figures 1a and 1b). Note that, even with a limited number of observations, the same relative trends were observed for fishes and marine plants (see Figures 1c and 1e). Figure 1d, however, shows the opposite trend for invertebrates.

EXOGENOUS IMPACTS ON MARINE MAMMALS

SEALING IN THE FALKLANDS started with de Bougainville's French colony in Port Louis in 1775. The first fur seal cargo was exported from the South Atlantic to Canton, China, in 1784. In the late 1700s, the fur seal population in the Falklands experienced withdrawals averaging two thousand to four thousand seals per ship per voyage. Given the estimate of 102 sealing vessels operating in the area and the average seal withdrawals given above, the number of fur seals, Arctocephalus australis, caught in the region would have amounted to more than 300,000 per voyage. The extraction of fur seals increased by 71 percent from 1775 to 1793 and continued at an average of 10 percent per year to 1821.

Fur seal skins and whale oil having increased in value, Louis Vernet (then governor of the Falkland Islands and its dependencies) invited immigrants from the Americas to establish agricultural businesses and to engage in whaling in the islands. Fourteen years later, the once prodigiously numerous seals were being "foolishly annihilated." By 1919, the fur seal population in Beauchene Island was locally extirpated. Sea lions, Otaria flavescens, suffered a similar fate with a 7 percent rate of extraction per year from 1928 to 1952. Associated sealing activities led to the extirpation of elephant seals, Mirounga leonina, from the Falklands in 1871.

Whaling, which began surreptitiously in the early 1700s (fur sealers switched to whaling when whales were found), flourished in the mid 1800s with as much as six hundred sailboats plying the southern seas. This was undoubtedly a result of the invitation extended by Louis Vernet to American whalers. Whaling diminished steadily with the decrease in the price of whale oil during the second half of the nineteenth century. However, the introduction of the explosive harpoon gun by Svend Foyn in 1866 led to more efficient whaling and in 1904, the first whaling company, Compañía Argentina de Pesca, was established in Buenos Aires. This company exploited South Georgian waters and, by 1915, the Falkland Islands and its dependencies held the most important fishery of whales in the world. It had twenty-one whaling companies, six coastal and two floating processing stations and a seasonal production of 430,000 barrels of whale oil. The species of whales harvested in and around the Falkland Islands were primarily Fin whale, Balaenoptera physalus, and Sei whale, B. borealis. Given that a twenty-meter Fin whale gave fifty barrels of oil and a ten meter Sei whale gave about twenty-five barrels, we estimate a maximum of about 9,000 whales killed per year.
Table 3. Some Records on the Exploitation of Marine Mammals and Penguins.

<table>
<thead>
<tr>
<th>Year</th>
<th>Extracted</th>
<th>Abundance</th>
<th>Area</th>
<th>Organism/Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1766</td>
<td>900</td>
<td></td>
<td>Falkland Islands</td>
<td>Elephant seals⁰⁰</td>
</tr>
<tr>
<td>1775</td>
<td>13,000</td>
<td></td>
<td>Falkland Islands</td>
<td>Fur seals (skins)⁰¹</td>
</tr>
<tr>
<td>1791</td>
<td>102</td>
<td></td>
<td>Southern Oceans</td>
<td>Sailboats⁰²</td>
</tr>
<tr>
<td>1793</td>
<td>361,900</td>
<td></td>
<td>South Seas</td>
<td>Fur seals (skins)⁰³</td>
</tr>
<tr>
<td>1821</td>
<td>202,500</td>
<td></td>
<td>South Seas</td>
<td>Fur seals (skins)⁰⁰</td>
</tr>
<tr>
<td>1850</td>
<td>600</td>
<td></td>
<td>South Seas</td>
<td>Sailboats⁰³</td>
</tr>
<tr>
<td>1865</td>
<td>2,250,000</td>
<td></td>
<td>Stanley, East Falklands</td>
<td>Rockhopper and Gentoo penguins⁰⁰</td>
</tr>
<tr>
<td>1871</td>
<td>0</td>
<td></td>
<td>Falkland Islands</td>
<td>Elephant seals⁰⁰</td>
</tr>
<tr>
<td>1881</td>
<td>40</td>
<td></td>
<td>Stanley, East Falklands</td>
<td>Sailboats⁰⁵</td>
</tr>
<tr>
<td>1904</td>
<td>1</td>
<td></td>
<td>Falkland Islands</td>
<td>Steamers⁰⁵</td>
</tr>
<tr>
<td>1912</td>
<td>430,000</td>
<td></td>
<td>Falkland Islands</td>
<td>Balaenoptera musculus oil barrels⁰⁵</td>
</tr>
<tr>
<td>1915</td>
<td>21</td>
<td></td>
<td>Falkland Islands and dependencies</td>
<td>Steamers⁰³</td>
</tr>
<tr>
<td>1919</td>
<td>11</td>
<td></td>
<td>Beauchêne Island, Falklands</td>
<td>remaining Fur seals⁰³</td>
</tr>
<tr>
<td>1933</td>
<td>39,700</td>
<td></td>
<td>Albermarle Sation, West Falklands</td>
<td>Sea lions⁰⁵</td>
</tr>
<tr>
<td>1971</td>
<td>5,000</td>
<td></td>
<td>Falkland Islands</td>
<td>recovering Elephant seals⁰⁰</td>
</tr>
<tr>
<td>1994</td>
<td>20,000</td>
<td></td>
<td>Falkland Islands</td>
<td>recovering Fur seals⁰³</td>
</tr>
</tbody>
</table>

TIME SERIES TRENDS AND EXOGENOUS IMPACTS ON MARINE ANIMALS

Because most sources on extractive activities in the Falkland Islands dealt with marine mammals, we were only able to validate the time series of perceived abundance for this group. The data on seals (fur and elephant) and sea lions (Table 3) plotted in Figure 2 corroborate the decrease in relative abundance of marine mammals suggested in Figure 1a. In view of these results, we can conclude that our methodology validates the usefulness of anecdotes as data sources for marine mammal biodiversity trends.

Note, however, that the decreasing trends demonstrated in Figures 1a-1c were not replicated for invertebrates (Figure 1d). The explanation that comes to mind is that the large and mobile marine mammals, seabirds, and large pelagic fishes were far more visible to explorers and voyagers than the usually smaller and sessile invertebrates. The increase in perceived abundance toward the mid 1800s may be an artefact resulting from the more thorough scientific expeditions, which sampled all groups of marine organisms. However, we could argue that by this period, the populations of larger, more profitable resources had declined and the colony's need to identify other sources of profit generated further explorations of their coastlines, leading to the higher "visibility" of populations of molluscs and crustaceans that before were used only for local subsistence.⁰⁷

CONCLUSION

In his contribution on the "shifting baseline syndrome of fisheries," Daniel Pauly defined anecdotes as earlier knowledge, extracted from the historical and anthropological literature.⁰⁸ He defended the importance of such observations in shifting the baseline of knowledge in marine fisheries beyond the start of industrialized fisheries, and he proposed that fisheries managers and policy makers develop frameworks to incorporate knowledge from the past two hundred years or more into contemporary attempts at ecosystem-based fisheries management. Moreover, the use of historical information in establishing the major impact of overfishing on marine ecosystems was convincingly demonstrated by Jackson, et al., using data spanning 125,000 years of ecological records.⁰⁹

Our study suggests that qualitative data can be standardized and transformed to a semi-quantitative format for time series trends analyses and may have the potential to be used in validating trends obtained from ecosystem models—Ecosim and Ecospace, analyses of trophic levels or archeo- and paleoecological studies.¹⁰ The challenge to reacquire such data remains to be met, however, and we believe that continuing to populate the database used in this study and extending its coverage to more geographical areas will facilitate future analyses of this genre.¹¹ This will give a new life to the often forgotten stacks of documents hidden in the various rare book collections in museums, libraries, and private collections around the world. Environmental historians are well positioned to take advantage of these resources in the ongoing efforts to reconstruct the history of the marine world.
Dr. Maria Lourdes D. Palomares is a research fellow of the Sea Around Us Project, Fisheries Centre, University of British Columbia (Vancouver, Canada), whose main interest is in extending knowledge baselines of marine biodiversity further in time. She is also project coordinator of the SeaLifeBase project, a FishBase-like relational database focused on marine invertebrates. Elizabeth Mohammed is a PhD student at the Fisheries Centre working on ecosystem models of the Caribbean as well as reconstructing catches in the area. Dr. Daniel Pauly is a professor at the Fisheries Centre and principal investigator of the Sea Around Us and SeaLifeBase projects.

NOTES

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5. A. J. Pernetty, The History of a Voyage to the Malouine (or Falkland) Islands Made in 1763 and 1764 under the Command of M. de Bougainville, in Order to Form a Settlement There: and of Two Voyages to the Straights of Magellan, with an Account of the Parotogons (trans. from Dom Pernetty’s historical journal written in French) (London: printed for W. Goldsmith and D. Steel, 1773).


17. Callender, Voyages to the Terra Australis, 63.


20. J. M. H. Nates by a Naturalist

21. J. M. H. Nates by a Naturalist

22. Probably penguins, given that they were on Penguin Island at the time of observation.

23. Five ships at one hundred men each would have amounted to five hundred mouths to feed. Kerr’s 1824 interpretation of Sebald de Weert’s observations upon arriving at Penguin Isle on April 6, 1599; Kerr, “Voyage of Sebald de Weert to the South Sea,” 133.

24. Boyson, The Falkland Islands, 27, identifies this as a shrimp, Munida surrugosa, “much liked by whales and penguins.” The genus Munida belongs to the decapod family of squat lobsters, Galatheidae, and the species occurring in the Falklands is Munida surrugosa, with benthic adults but planktonic larvae; see F. Tapella, et al., “Reproductive Biology of the Crab Munida Subrugosa (Decapoda: Anomura: Galatheidae) in the Beagle Channel, Argentina,” Journal of the Marine Biological Association 82 (2002): 589-95. However, the swimming description might refer to what


30. A timeline is available at www.falklands.info.


32. See section on exogenous impacts.


35. Ibid.

36. Letter to Caroline Darwin, April 6, 1834; cited in Armstrong, *Darwin's Desolate Islands*, 100-103.


48. Stevenson, "Les pécheries de baleines des îles Falkland."


51. Bonner, "The Fur Seal of South Georgia."

52. Mill, *The Siege of the South Pole*.

53. Stevenson, "Les pêcheries de baleines des îles Falkland."


55. Strange, *The Bird Man*.

56. Strange, *The Falkland Islands*.

57. Charton, "Illes Malouines ou Falklands," 266. See also Armstrong, "Human Impact on the Falkland Islands Environment."


