

THE REAL SEA CHANGE

What can pirates' journals and centuries-old cookbooks teach modern-day ecologists? **Mark Schrope** meets the researchers who trawl history books for deeper insights into marine ecosystems.

In the late 1600s, Alexandre Olivier Exquemelin was busy living up to his extravagant name. In his book *The Buccaneers of America*, the French-born pirate describes a host of battles and "barbarous inhumanities" through the Caribbean and along the South American coasts. He writes about some pirates' habit of taking Cuban sea-turtle fishermen as slaves, and he personally owns up to stealing victuals left ceremonially by grieving widows at their husbands' graves.

But between all the sacking and pillaging, careful readers can also find glimpses of natural history. A description of a green sea turtle reads: "Their eggs... are found in such prodigious quantities along the sandy shores of those countries that, were they not frequently destroyed by birds, the sea would infinitely abound with tortoises... Certain it is that many times the ships, having lost their latitude through the darkness of the weather, have steered their course only by the noise of the tortoises swimming that way, and have arrived at these isles."

Today, a growing number of marine scientists argue that researchers focus too narrowly on recent decades and don't make proper use of historical records to put their work in context. Clearly, the most recent data are also the most thorough. But some argue that findings from such studies are improperly informed at best, and at worst support fundamentally flawed management schemes. What if, for instance, an ecosystem had been severely degraded a century earlier, but the general understanding of the ecosystem — including restoration targets for fish and other marine creatures — was based on observations made over only a few decades?

Time team

One way to resolve this is to look at the past, and detectives in the emerging field of historical marine ecology are doing just that, scouring archives, museums and archaeological and palaeontological records. They root through relatively straightforward data, such as how many fish were caught in a particular harbour. But they also have to get creative, delving into obscure sources such as pirate logs, medieval cookbooks and restaurant menus that track the availability of seafood.

Most historical marine-ecology projects fall under the Census of Marine Life, a ten-year global initiative with the ambitious goal of cataloguing everything that lives in the

ocean. An arm of the programme — History of Marine Animal Populations (HMAP) — aims to determine what used to live there. By 2010, researchers will have examined more than a dozen key sites around the globe; historical studies are already under way in southwest Africa, Australia, Europe and the United States, including the latest, a study of the Florida Keys. Further work is planned in southeast Asia and New Zealand.

HMAP was designed to correct the "historical myopia" of fisheries scientists, says Tim Smith, one of the programme's leaders and a fisheries biologist retired from the National Marine Fisheries Service in Woods Hole, Massachusetts. In 1995, a seminal paper appeared describing the basic problem as "shifting baseline syndrome"¹. In it, Daniel Pauly of the University of British Columbia argued that researchers base their understanding of healthy

fish populations on what fish stocks are like during their lifetimes, with no framework for incorporating how much more plentiful fish might have been in generations past.

Although historical documents can shed light on this, there are limits, says David Starkey, another programme leader and historian at the University of Hull, UK. "You can never revisit the past and replicate what went on — you can only get glimpses of the past," he says. "That's an inevitable challenge." But not facing that challenge is a mistake, he believes.

The one-year Florida Keys project began in June and is designed to shift baseline observations of the ecosystem as close as possible to their positions before Europeans showed up. Graduate student Loren McClenahan, working with marine ecologist Jeremy Jackson at the Scripps Institu-

tion of Oceanography in San Diego, California, and others, is combing Spanish and British archives for records dating back to the 1600s, and US libraries for accounts from the 1800s onwards. She hopes to learn how far coral reefs used to extend around the Keys, as well as the population history for 14 important species including mangrove trees, grouper fish and the now-extinct Caribbean monk seals.

Rogues' gallery

Some sources are richly detailed. In 1803, US commissioner Andrew Elicott wrote in his journal: "Along the Florida Reef, and among the Keys, a great abundance and variety of fish may be taken: such as hog-fish, grunts, yellow tails, black, red, and gray snappers, mullets, bonefish, amber fish, margate-fish, baracoota, cavallos, pompui, groopers, king-fish, siber-fish, porgys, turbot, stingrags, black drum, Jew fish, with a prodigious variety of others, which in our situation we found excellent."

In an earlier related study², McClenahan and Jackson looked at historical populations of sea turtles throughout the Caribbean. They found the late-seventeenth-century writings of a buccaneer named William Dampier particularly useful. For instance, he described the location of turtle nesting areas and aggregations in enough detail for modern scientists to map them accurately.

Pirates may seem notably suspect as sources of information. Many pirate accounts exaggerate their exploits, says Starkey, because interesting tales from their world travels could make them money and also deflect attention from their illegal activities. But Dampier was one of the most scientifically significant and reliable, says Starkey, who has studied privateers, pirates and buccaneers. And later voyagers often confirmed Dampier's observations.

Even Charles Darwin recognized the value of Dampier's work. He carried some of the

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Tales of the sea: pirate journals dating back to the late 1600s can offer useful information on marine ecosystems.



A question of scale: archive material, such as this photo taken in Florida in the 1940s, can give fresh perspective on the abundance of certain species.

buccaneer's century-old writings on his voyage on *The Beagle*, and referenced them in his account of the trip. He described Dampier as "so accurate a person", noting that a volcanic peak in the Galapagos Islands that he found overgrown must previously have been barren, simply because Dampier described it as such. Even some of Darwin's early work on evolution and natural selection was inspired in part by Dampier's thoughts on "bastard" species, such as Galapagos sea turtles, that he thought must be a mix of species from different geographical areas.

Net gains

In Florida, some of the best descriptions of the historic Keys come not from pirates, but from surveyors, captains and doctors. Not surprisingly, the sources paint a collective view of the Keys quite different from today. In 1796, Scottish surveyor George Gauld wrote that "among the roots of the mangroves and about every old log or piece of rotten work, there are such quantities of the largest crayfish [spiny lobsters] that a boat may be loaded with them in a few hours". Today, divers spend hours filling just one bag. Other accounts spoke of plentiful fish and coral reefs where now only sand or rubble are found.

Tracking down such stories takes a combination of creative thinking and patience. "It's a little bit of a treasure hunt," says McClenachan.

Her greatest find to date is a 1775 map by Gauld that includes details about coral reefs to avoid and views of the approaches to specific islands, giving a snapshot of the area covered by mangrove. "It's just a complete gem," she says.

Based in part on similar analyses of historical sources, Jackson and his colleagues have concluded that coral reefs are in severe decline worldwide, largely as a result of human activities such as overfishing³. Such far-reaching extrapolations have fuelled an ongoing debate over reef health. Richard Grigg, a coral-reef biologist at the University of Hawaii at Manoa, says that although he favours the historical-ecology approach in general, he thinks Jackson's conclusions are too broad. "You have to be extremely careful with that kind of information," he says. "I think it's up to us as scientists to be extremely critical and not fall into sweeping generalizations about how the sky is falling."

For his part, Jackson argues that historical analyses can provide powerful tools for quantitative assessments. Anecdotal evidence, too, can be scientifically valuable, he says. If, for instance, records suggest that sea turtles in a region were once plentiful but are now scarce, that provides important ecological information

about the past — even without details of exactly how many there were.

Like the Keys project, an HMAP study led by Heike Lotze, a marine ecologist at Dalhousie University in Halifax, Nova Scotia, has taken a broad view of a complex ecosystem — in this case the Wadden Sea in northwestern Europe⁴. "If you go there today, most of the area is pro-

tected as a national park, so I think a lot of people envision it as a natural ecosystem," she says. But "500 or 1,000 years ago it was a completely different system. If you have this historical knowledge, you see how much humans have transformed it."

During medieval times, fish populations in rivers and lakes connected to the

Wadden Sea began to drop as people overfished it and built dams, which blocked the spawning migrations. Later dyke building also cut off estuarine nursery areas. Archaeologists have documented how fish populations plummeted — for instance, digs of waste piles from old fish markets show that sturgeon scales became increasingly less common. But cookbooks also tell part of the tale. Sturgeon was once popular even for common folk, but by the fourteenth century they were so rare that they were only served at the king's table. Later

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ERNA MOHR (1952), DER STÖR, AKADEMISCHE VERLAGSGESSELLSCHAFT, WESTARP WISSENSCHAFTEN, MAGDEBURG



Archaeological digs of waste piles near nineteenth-century sturgeon fisheries, such as Hamburg harbour, shed light on the fish's dwindling numbers.

French cookbooks held clues to the species' drop in numbers, such as instructions on how to prepare veal as a substitute in recipes calling for unavailable sturgeon.

As the more easily accessible freshwater fisheries collapsed, medieval fishers turned to coastal waters and then moved farther afield as fish populations there dwindled. The Wadden Sea isn't the only place where overfishing hit hard, of course. A team led by Andrew Rosenberg, a marine ecologist at the University of New Hampshire in Durham, has done extensive research to determine historical cod populations off the coasts of the United States and Canada.

Record catch

In one study, for instance, the group calculated the cod population on Canada's Scotian Shelf in 1852, based on detailed logs for schooners operating out of Beverly, Massachusetts⁵. The researchers think the information is reliable because the reporting system offered little incentive for fishers to misreport, and because there is some overlap among the logs. Overall, the study suggests that the 1852 cod population was two orders of magnitude larger than today.

And more than four-and-a-half centuries before the 1990s collapse of the Atlantic cod fisheries, there was an astonishingly rich population. In 1623, fisherman Emmanuel Altham wrote in a letter to his brother: "In one hour we got 100 great [very large] cod... and if we would have but stayed after the fog broke up, we might quickly have loaded our ship... I think we got 1000 in all... When we had nothing to do my

people took great delight in catching them, although we threw them away again."

Rosenberg says it is too soon to say whether fisheries managers will apply such historical records to their efforts. But Thomas Hill, acting chairman of the New England Fishery Management Council and a long-time fisherman based in Gloucester, Massachusetts, believes fisheries management in his region has indeed been hampered by a dependence on modern data. "I think any historical perspective is certainly important in developing long-term public policy," he says. "In the absence of that, you're shooting in the dark." Hill adds that a better understanding of the historical populations could help fishermen appreciate their collective impact.

One HMAP study that could have controversial management implications involves estimates of world whale populations. Smith has looked through sources such as customs-house records and period trade journals to estimate global catch rates for whale species including

the humpback and the North Atlantic right⁶. The problem is that newer genetic analyses estimate total population sizes in the 1800s to be at least an order of magnitude larger than those based on historic records⁷. In this case, pirate activities may have complicated the historical analyses, as whale catches for ships they captured were not recorded. Known sources of underreporting, though, would likely change estimates only by a few per cent, says Smith, and work continues to reconcile the discrepancy.

Despite such controversies, the HMAP researchers believe that their work is gaining momentum and acceptance. "The hybridization of history and ecology has really put a set of new questions on the table that, together, the scholarly community has been able to answer," says Jesse Ausubel, an ecologist at Rockefeller University in New York and programme director for the Census of Marine Life at the Sloan Foundation. And overall, says Jackson, the work has potential to make a real impact. "It's a whole new way of viewing the world," he says. "If in some small way this can shape ecological research for the future and help us to conserve biodiversity, then that will be wonderful."

Indeed, if Darwin is any indicator, even a pirate could help shape that future. ■

Mark Schrope is a freelance writer in Florida.



Artists' impressions from Scandinavia (c. 1555) indicate an abundance of river fish populations.

DAGLI ORTI (A)/ART ARCHIVE

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