NOTE FROM THE EDITOR

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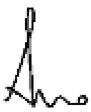
Dear Friends, Colleagues and Otter Enthusiasts!

Welcome to a new issue in the New Year! This year marks the 20 year anniversary of the first issue of the IUCN OSG Bulletin produced with me as an editor. Please allow a few lines of personal reflection on this period. 20 years ago there was no review system in place nor did we even discuss it and the booklets were thin copies by then. Looking back there was quite some evolution in this "species" such as the introduction of covers in colour and on thicker paper, abstract translation into French and Spanish and sometimes more exotic languages, various governmental and non-governmental organisation and companies sponsoring single issues, the first paid advertisements, the introduction of a review system first only for articles that was introduced later for all manuscripts and finally after long discussions probably the most important change to the online-only version with downloadable pdfs. All these activities resulted in over 400 papers on otters that have been published in total since the first issue was produced by Chris Mason back in 1986 and Dave Rowe-Rowe who took over in 1991. I have been informed that the IUCN OSG Bulletin will be listed in Scopus and therefore in addition to other guidelines an ethical statement on ethics in science and plagiarism etc. has been added to the website in 2013. Almost all old issues have been meanwhile digitalized by Lesley and are included in the seachable database on our website but also on the website of the Directory of Open Access Journals (DOAJ.org).

The OSG will have a meeting of the Steering Committee later in February in Luxembourg where we have already an extensive agenda ranging from conservation issues to the last preparations for the 2014 International Otter Colloquium in Rio de Janeiro in August (https://sites.google.com/site/ottercongress/submissions). I am looking forward to this chance to discuss important issues of otter conservation and science and to meet friends again.

However, and last but not least, without Lesley much of what we have achieved with the Bulletin would not have been possible. Lesley is the good angel behind the whole website and me having no idea on how to do a website the guess on how mcuch work this is will always be an underestimation of what it really means. Lesley, as in the last sentence of all my editorials - thanks for all your continuing support.



O B I T U A R Y

The Hon. John Vincent Weir
8th February 1935- 15th February 2014

The Honourable John Vincent Weir, known to the conservation world as Vincent Weir, was a big man, both in stature and in his breadth of vision and determination. Shy and modest, he resolutely went his own way, doing what he thought needed doing and avoiding publicity. This has meant that his work has not been appreciated as widely as it deserved and his name is not widely known, but few of the well known names have done as much for wildlife as Vincent did.

It was as a school boy in Malvern that Vincent was attracted by a painting by Peter Scott and developed an enduring love of wildlife. Through first shooting, then studying, wildfowl Vincent discovered otters and was hooked. From 1969 he would spend long, cold hours, smoking to keep awake, in hides in Norfolk and Suffolk, studying and attempting to discover the causes of the otters' decline. During one of these vigils he heard a bittern booming nearby but could not spot it anywhere. As he looked a spike appeared at the window in front of him and gradually rose until he could see the bittern's head and one eye peering at him. Man and bird eyed each other sardonically, then the bittern slowly descended as it had come. Vincent never forgot that bird.

Realising that his efforts alone could not save his beloved otters, Vincent founded The Vincent Wildlife Trust in 1975, employing first two lobbyists to campaign for the otter's inclusion on the forthcoming Wildlife and Countryside Act. His initial idea was a two pronged effort to get legal protection and to research and reverse the causes of the otter's problems. To establish baseline data on otter populations in the British Isles the VWT employed surveyors to cover England, Scotland, Wales and Ireland. By the time the first otter surveys were complete over 11,000 sites had been surveyed using common methodology. This time consuming and expensive project laid an invaluable basis for otter studies in the UK. The national otter surveys have been repeated at seven year intervals since 1977 giving a unique history of changes in an otter population over nearly 40years. Vincent did not restrict his efforts to British otters, but sent out his employees to carry out preliminary surveys over most of Europe and North Africa and trained visiting groups of otter people from Europe. Having established a population baseline, the VWT diversified its activities to address the problems facing the otter in Britain. The Otter Haven Project was established to promote otter conservation and habitat improvement. Studies on the effects and distribution of pollutants were undertaken, together with ground breaking radio tracking work in Scotland. Work on the impacts of eel fisheries, marine fish farming and creel fishing followed, resulting in the supply of thousands of free fyke net guards to licensed eel trappers. Long term study of otter road mortality provided the background to the development of mitigation measures to limit this major form of unnatural mortality.

As the otter population gradually recovered from its low point it became clear that injured and orphan otters were becoming more common, so a rehabilitation centre was established giving rise to veterinary studies and reintroductions. By 2000 the British otter population had recovered over most of its range and the need for concentrated work was considered to be over. Vincent had seen his vision fulfilled. He had long had other interests and had been extending the operations of the Trust over the years. In the early days red squirrels were surveyed on the Isle of Wight. Bats were early beneficiaries, and practical as always, Vincent not only funded research, but bought and preserved the roosts of rare bat species, later becoming the main sponsor of the Bat Conservation Trust and endowing the Vincent Weir Scientific Award which has funded many students. Great crested newts were another early beneficiary, leading to Vincent becoming the founder and patron of the Herptological Conservation trust, later the Amphibian and Reptile Conservation Trust. The reserves bought by the VWT for bats and newts also had threatened butterflies and wild flowers, so began the sponsorship of the Butterfly Conservation Trust and Plantlife. Vincent's first love for freshwater life was reflected in sponsorship of the Wildfowl and Wetland Trust and in the VWT's timely work on water voles, which Vincent had enjoyed during his early otter studies, but by the 1980s were disappearing from British waterways. The otters' relations and other carnivores were not forgotten with ongoing work on pine martens and polecats and study of Scottish wildcats in the early 1990s. British animals were not the only ones to benefit from Vincent's generosity as he regularly contributed to projects on species throughout the world. Increasingly the Trust became a less hands on organisation and more an enabling body. Vincent was very aware that many small charities were forced to spend more time fundraising than pursuing their conservation goals. Several of our most successful wildlife charities owe their success in part to generous endowment which put their funding on a secure footing.

Jim and I began working for the VWT in 1977 with the first Scottish otter survey and stayed with the Trust for 18 and 23 years respectively. As an employer Vincent could be quixotic at times. We grew to treat the early morning 'phone calls that meant Vincent had been thinking in the bath with some trepidation, as he thought an abrupt change of direction in the middle of a project could be accomplished overnight. But these were minor problems compared with the enormous opportunities working for Vincent opened up. How else would we be paid to travel all over Scotland, have numerous fascinating encounters with wild otters and care for nearly 150 otters? Vincent had a great sense of humour and gloried in sheer silliness so the quarterly trust meetings were often hilarious. His party piece was an imitation of a steam train, but we could not often get him to do it. In 1979 one of the Bank Line ships, the Roachbank, picked up a sinking boat load of Vietnamese refugees, at a time when there were commercial penalties to such humanitarian acts. Vincent took an interest in his boat people visiting them and entertaining the children with his steam train. One wonders what the traumatised children made of the giant of a man making train noises for them.

Few people can have done so much for the conservation of wildlife and habitats and yet be so little known. From the 1970s, when otters in England had slipped almost unnoticed to the verge of extinction, to the present day when otters are present through out the country, Vincent showed his love for them in intensely practical ways. He took pride in being able to respond at once to urgent need. Those of us whose lives were influenced by Vincent or who love otters will remember him with affection and gratitude, but he will not get the recognition his work deserves, which is probably the way he would wanted it.

OBITUARY

James Leigh Roslin Williams MBE
5th February 1939 - 4th February 2014
Vic Simpson

It is a great irony that some of the most influential people in wildlife conservation have also been hunters – Theodore Roosevelt was instrumental in establishing the National Parks System in the USA yet went on game shooting safaris in Africa, Sir Peter Scott created the Wildlife and Wetland Trust in the UK but started life shooting wild geese for sport. James Williams may not have been as well known as these luminaries but he was hugely successful in combining his love of hunting, fishing he was awarded an MBE (Member of the British Empire) in the Queen's Birthday Honours. The award was presented to him by Prince William and shooting with a life time commitment to the conservation of otters. His achievements in otter conservation were recognised in 2013 when at Buckingham Palace. Shortly after this he was elected a Fellow of the Linnean Society, a rarely bestowed honour and one of which James was justifiably proud.

James grew up in Westmorland, a rural county of hills and moors, rivers and lakes in North West England. There, under the guidance of his father, he learnt to fish, shoot and hunt with hounds. In so doing he learnt about relationships between predator and prey, species and habitat, food availability and season and the many other things that make the natural world function. After leaving school James went to St Andrew's University in Scotland where, perhaps surprisingly in view of his love of natural history, he took a degree in classical languages rather than zoology. However, the degree served him well as James went on to teach English, initially at a boys' school in north west England but then at Taunton in Somerset. From an otter conservation point of view this move to south west England was to prove fortuitous in later years

James' father had been a Master of Otterhounds and James undoubtedly learnt a great deal about the habits and behaviour of otters as he accompanied him on hunts. It was not surprising that in later years James too, became a Master. At that time otters in the UK were widespread but when, during the 1970s, it became apparent that the otter population had collapsed the hunts voluntarily stopped hunting. It was always a source of annoyance to James that so little use was made of the great expertise that the hunts had on otters or the hundreds of years of records that they kept. This frustration is evident in a publication by James in a 1989 OSG Bulletin where he recalls that between 1957 and 1980 - the main period of the decline – the hunts recorded 26 apparently blind otters with white or opaque eyes. However, no proper post-mortem examinations were carried out and James concludes "*An opportunity to learn much has been lost*". In view of later research carried out in Cornwall on eye lesions in relation to pollutants and vitamin A this is almost certainly true!

One of James' other passions was fishing, particularly for salmonids. In fact it was whilst on a fishing outing on the River Exe in Devon in 1968 that he proposed to his girlfriend! It is said he "*was so re-assured by Elizabeth's response that he risked popping off to fish … leaving her to pack away the picnic alone*."! However, Elizabeth is an equally competent and enthusiastic fisherman and this undoubtedly contributed to their enduring relationship. And wherever they fished, be it Devon or Scotland or some distant land, they always kept an eye open for otters!

During the 1970s and 1980s, when the crash in the otter population had become all too apparent, the Vincent Wildlife Trust funded and ran the Otter Haven Project. This involved doing surveys for evidence of otters and one of its officers, Libby Lenton, sought James' assistance in carrying out surveys of Somerset's rivers. Signs such as spraints and pad marks, let alone sightings, during this period were depressingly few and far between. More extensive surveying was needed and this required 'Manpower'! With James' infectious enthusiasm and persuasive ability the Somerset Otter Group (SOG) , which had become quiescent with the decline of otters, was re-launched. James was elected Chairman and soon teams of volunteers were persuaded to turn out for surveying on prescribed dates and locations each year. The results were then assembled, analysed and discussed at regular SOG meetings. These evening meetings were also social events, usually held in a pub, often with an invited speaker. Under James' dynamic leadership the SOG went from strength to strength and it is largely thanks to his unrelenting determination that Somerset's otter population is almost certainly the most thoroughly surveyed in the UK.

Another major strength of the SOG was the recording of dead otters and, where possible, their collection for post-mortem examination. The cause of the population crash had never been established and even as late as the 1980s there was no system in place for proper post-mortem examination of otters in the UK. Vic Simpson, a veterinary surgeon working at the Ministry of Agriculture Veterinary Investigation Centre in Cornwall had started to examine the few otters found dead each year in Cornwall and Devon but this work was unofficial. However, in 1995, partly as a result of EU legislation on water quality, the National Rivers Authority (which later became the Environment Agency), undertook to fund post-mortem examinations on otters and perform toxicological analysis on their organs. As originally envisaged, otters from Cornwall and Devon would be examined by Vic but those from other counties would be examined at the School of Biological Sciences, Cardiff University . James felt strongly that it would be preferable to have the Somerset otters examined at the same laboratory as those from neighbouring Devon. When Lyn Jenkins, the NRA officer in charge of this project, also recommended this it was agreed that not only otters from Somerset but also from the other counties in southern England should be sent to the government laboratory in Cornwall. When Vic retired from government service in 2001 and set up the Wildlife Veterinary Investigation Centre this arrangement continued and the result was a long and fruitful relationship between the NRA/Environment Agency, SOG and the other county groups, and Vic.

The momentum for research into otters increased markedly during the 1990s and when, in 1998, the Otters and Rivers Project superseded the VWT project otter research took another big step forward. The project was a partnership between the Environment Agency, the county Wildlife Trusts and the water industry and James became the project officer for Somerset Wildlife Trust. Although one of the main aims of the project was to monitor the levels and possible effects of environmental pollutants on otters it was also a means by which to learn more about otter biology and disease.

One disease that James became particularly involved in was infection with the bile fluke *Pseudamphistomum truncatum*. This parasite was not known to occur in the UK until 2004 when it was discovered by Vic Simpson in three otters from Somerset. As the parasite had not been seen during earlier post-mortems the question arose as to where it had come from. The parasite is carried by fish and James, with his intimate knowledge of the area, pointed out that two alien species of fish, imported from

eastern Europe where the parasite is common, had recently colonised the Somerset Levels. The findings were published with James as a co-author and there followed a series of publications and research into the parasite. However, in 2007, following severe government–imposed cuts to their budget, the Environment Agency ceased funding otter research at the Wildlife Veterinary Investigation Centre. James was forthright in expressing his displeasure but as Cardiff University were managing to continue their work – and they had also started to study *P. truncatum* – he threw his weight behind supporting them. James was a man of action and when his deep freezers were full and no transport was forthcoming he even delivered the frozen bodies to Cardiff himself! He also most generously provided personal financial support for their research, including the cost of attendance at the IUCN XIth IOC conference in Pavia in 2011. This was total commitment.
Anyone who ever talked to James, or more particularly read one of his letters, would appreciate his command of the English language. He could be witty and amusing but also outspoken and fearless, particularly when expressing his views or recalling his experiences in life. It was no surprise therefore when he decided to write a book about otters. "The Otter Amongst Us" was published in 2000 and is a record of James' lifetime observations on otters and is a delight to read. He went on the publish a second book "The Otter" in 2010 which is based largely on the results of the scientific papers that James and other otter enthusiasts had made possible.

There is a saying in English "They don't make them like that anymore" That is certainly true of James Williams.

R E P O R T

OTTERS AND EELS: LONG-TERM OBSERVATIONS ON DECLINES IN SCOTLAND

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Abstract: The summer diet of otters *Lutra lutra* has been monitored for almost forty years in a study area in NE Scotland. Since 2000, otter numbers and reproduction in the area have declined. At the same time the occurrence of eels (*Anguilla anguilla*) in otter faeces or 'spraints', formerly the otters' dominant prey, decreased substantially. This is seen against a well-documented sharp, probably global decline in numbers of eel. Otter predation on young water birds in the study area increased, as has predation on other fish species, and changes in importance of other prey are also documented. It is suggested that with otters being food-limited, the decline in eels should be of serious concern to otter conservationists.

Keywords: otter; *Lutra lutra*; eel; *Anguilla anguilla*; population decline; predation.

INTRODUCTION

Since the 1980s there has been a severe decline in recruitment to populations of eels (*Anguilla anguilla*) throughout Europe, a decline estimated at over 99% of numbers and continuing (Stone, 2003; ICES, 2012). As eels are one of the main foods for Eurasian otters *Lutra lutra* in many areas, and otter numbers likely to be food dependent (Kruuk, 2006), this is a trend of immediate concern for otter conservation management in Europe. There have been similar declines in eel recruitment in North America and Japan. In early 2013, however, an increase has been observed in numbers of eels in one area in Cambridgeshire, UK (Anonymous, 2013).

It is important to obtain detailed information on long-term changes in abundance of both otters and eels, in order to evaluate ecological impacts and to incorporate such data into management strategies. In one study area in NE Scotland, the Dinnet Lochs where, uniquely, observations have been made on otter ecology over a period of more than 35 years, the opportunity arose to analyse long-term changes in the importance of eels in otter diet, in parallel with approximate observations on otter presence and changes in other prey species.

STUDY AREA AND METHODS

The Dinnet study area is a National Nature Reserve in Aberdeenshire, Scotland, centred on two shallow lakes, Loch Kinord (80 hectares, Ord. Surv. Grid ref. NO441995) and Loch Davan (42 ha., OS grid ref. NJ442018; Fig. 1). It has been described earlier by Jenkins (1980). The lochs are habitat for only a few species of fish (eel *Anguilla anguilla,* pike *Esox lucius* and perch *Perca fluviatilis*), and salmon *Salmo salar* and trout *S. trutta* occur in in- and out-flows and in the nearby River Dee. In addition as important potential food species for otter, there are common frogs *Rana temporaria* and toads *Bufo bufo,* as well as many water birds.

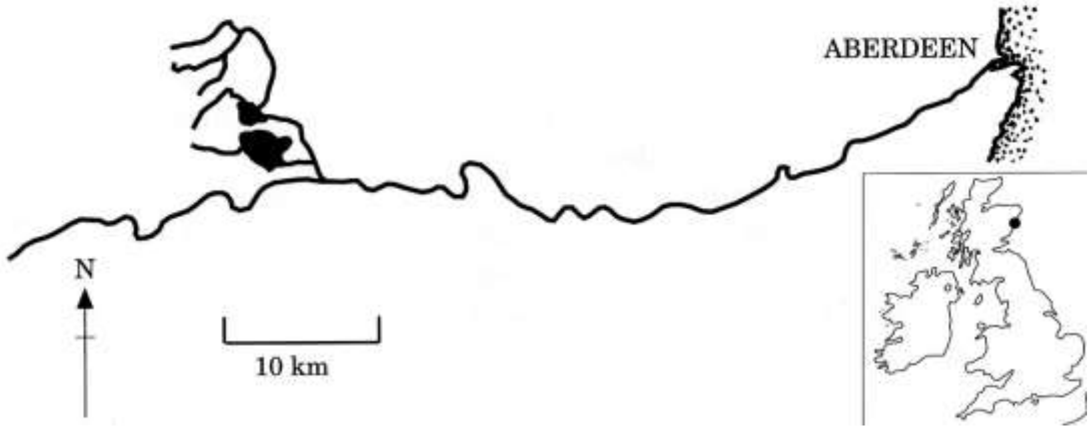

Figure 1. The River Dee in NE Scotland, with the Dinnet Lochs, Loch Davan (top) and Loch Kinord (bottom).

Visual observations on otters were made usually for several hours in early morning, though for longer times in the 1990s than later on. A measure of foraging efficiency was estimated by timing the period an otter was in the water, and registering the numbers of prey caught.

Earlier studies of otter diet in Dinnet were carried out from the 1970s onwards, starting with Jenkins et al. (1979, 1980), various student projects, and Carss et al. (1998), from whom diet data are quoted to compare with the present study. I observed otter foraging in Dinnet from 1988 onwards, and started faecal (‘spraint’) analysis in Dinnet in 2003. From then on fresh spraints were collected yearly during June, until and including 2013, noting that previous year-round studies had shown that eels were more important in the Dinnet otter food in midsummer, June, than during other months (Jenkins et al., 1979, 1980). Every year 50 fresh spraints were collected in plastic tubes, 25 from each of the two lochs, and preserved deep-frozen.

For analysis, each spraint was soaked in hot washing liquid, rinsed in a 0.7mm sieve, and the content analysed in a petri-dish, using 2-8x magnification. Fish remains (vertebrae, scales) were identified to species using collected specimens for comparison and Conroy et al. (1993). Eel vertebrae were measured and measurements converted into individual prey lengths and weights, using equations in Carss and Elston (1996). Remains of amphibians, birds and mammals were identified only down to their class, and other prey categories (e.g. insects), being insignificant as otter prey, were noted but not used for further analyses. Results were expressed as percent of spraints containing a given prey category.

RESULTS

Visual observations on otters at Loch Davan showed a decline in numbers over the study period. During winter, which is the best season to observe otters because of seasonal changes in light conditions and vegetation, in 254 hours early morning observations from 1993-2000, otters were seen on 211 occasions, a mean 0.83 different otters per hour. On several occasions a number of otters were seen per observation period, with a maximum of six different otters. This frequency declined to 27 otters seen over a total of 48.4 hours observation during 2000-03 (0.56 otters per hour, of which more than 70% during the first of these years), and despite frequent watches, only occasional observations thereafter (unpubl. pers. obs.).

Despite the paucity of visual observations during the latter period, there was evidence of the presence of one or two otters (spraints), but this was little when compared with evidence in the preceding period when there were many conspicuous otter trails and couches in the reed beds and other bank vegetation. Such field sign of otter presence was even scarcer during 2003-2013. One otter holt in the bank of Loch Kinord was in continuous use by different otters until 1994, less frequently thereafter until 2003, and no longer after that.

Up to 1994 one to three litters of cubs were present every year (Jenkins, 1980; Kruuk, unpubl. obs.), probably produced along one of the two lochs or in neighbouring reed beds (Taylor and Kruuk, 1990). However, there was no evidence of litters born at the lochs after that date, and there were only occasional visits by otter families.

Observing the amount of time otters were swimming and diving during the 2000-2003 study period, and noting the numbers of prey taken: over a total of 13:14 hrs foraging the animals caught 27 prey, spending 29.4 minutes per prey. This compares with earlier observations from 1990-1994 when 152 prey were caught in 52:48 hrs, or 20.8 minutes per prey, a 41% decrease of speed of catching prey. Jenkins (1980) calculated that in 6:06hrs of observation at Dinnet over the 1970s, otters spent 7.6 minutes per prey.

There was considerable annual variation in the occurrences of different diet items. Between 2003 and 2013, eels occurred in 34 to 98% of the June spraints, birds (almost all juveniles, mostly ducks) in 2 - 74%, amphibians in 2 - 42%, fish other than eels (mostly pike) in 8 - 48%, mammals in 0 - 18% and invertebrates in 2 - 16%. The last three prey categories, when present, usually constituted only a small or very small proportion of the entire spraint content, in contrast with eels and birds, which tended to dominate spraint contents.

Eels, having been present in large quantities in the great majority of spraints in the two lochs in June in the 1970s and 1990s (Jenkins et al., 1979, 1980, Carss et al., 1998), declined significantly in prevalence in later years, down to being present in only 34% in 2013 (Fig.2).

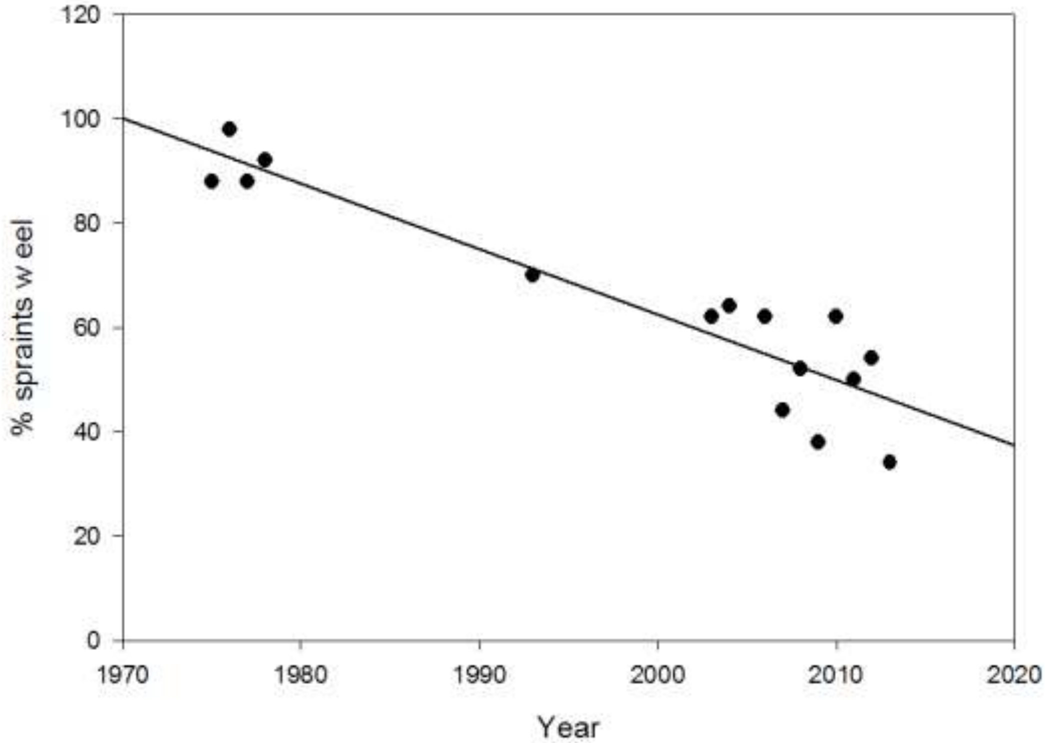

Figure 2. Eel remains in Dinnet otter spraints, 2003-2013. Spearman Rank: rs=-0.865 n=15, *P*<0.01

Eels that were taken also declined in size over the study period, from a calculated mean weight of 421g in 2003, to 305g in 2013, a decline of 28% (Fig. 3). The eel weight data are likely to be underestimates, due to the bias of under-estimation of the occurrence of larger vertebrae in spraints (Carss and Elston, 1996). Therefore the actual decline of eel size over the years is probably more pronounced.

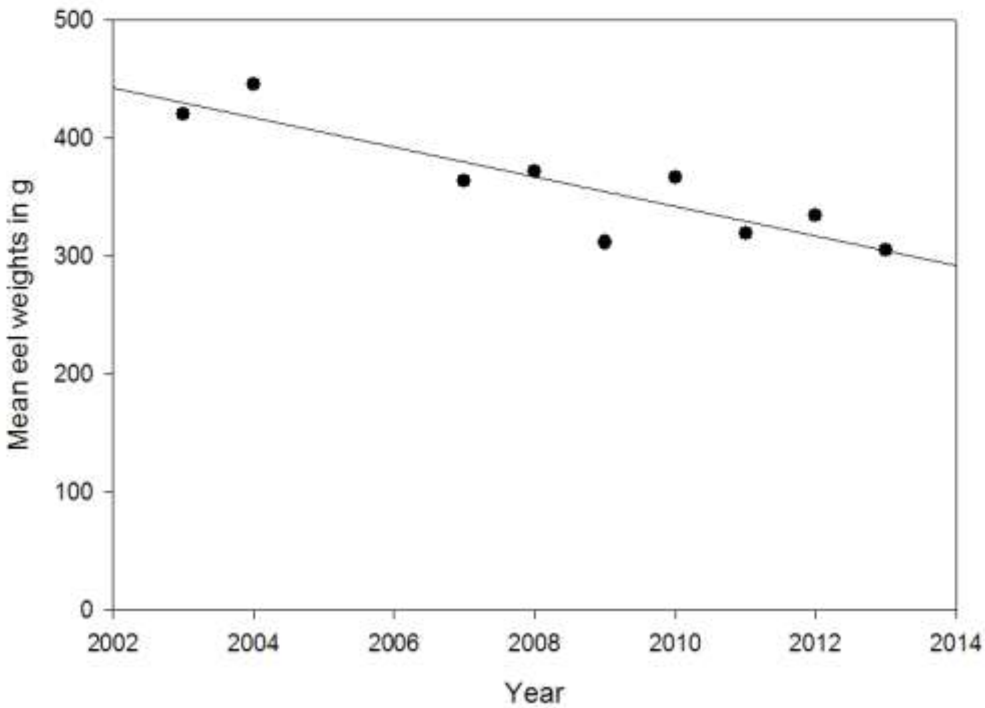

Figure 3. The mean size of eels in grams, calculated from vertebrae in spraints. (nos. of vertebrae measured from 2003-2013: 26, 4, 47, 67, 34, 40, 60, 65, 27), Spearman rs=-0.800 n=9, *P*<0.01.

Over the same period, the occurrence in spraints of fish species other than eels was relatively unimportant, but rose significantly (Fig. 4). When these other fish species were present in a spraint, this was usually in small quantities, e.g.as a single vertebra or a few scales.

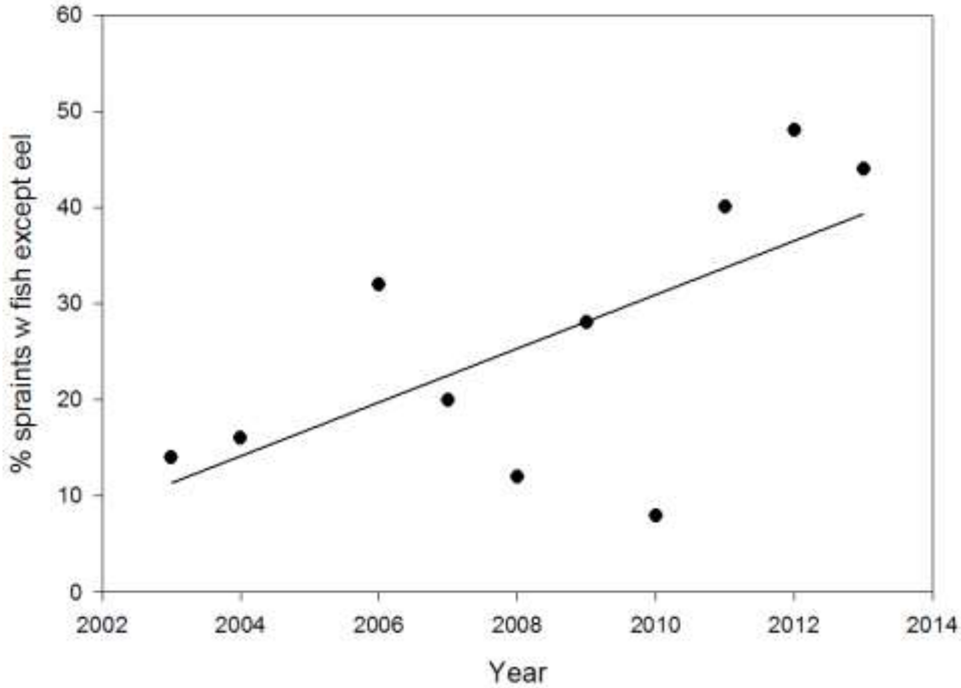

Figure 4. Remains in spraints of fish other than eels, 2003-2013. Spearman rs=0.564 n=10, $P<0.05$

Particularly striking was the increase in otter predation on birds (Fig. 5), many of the spraints in the later years containing nothing but feathers of small duckling, moorhen or coot. In 2011 one spraint contained remains of a goldeneye duckling (*Bucephala clangula*) that had been colour-marked with dye in a parallel study of that species in Dinnet (H. Scott, pers. com.). The increase in bird predation was especially steep during the last ten years. In the most recent years there were several observations of otter predation on adult greylag goose (*Anser anser*), young goslings, and adult teal (*Anas crecca*), from remains along the shores or tracks in snow.

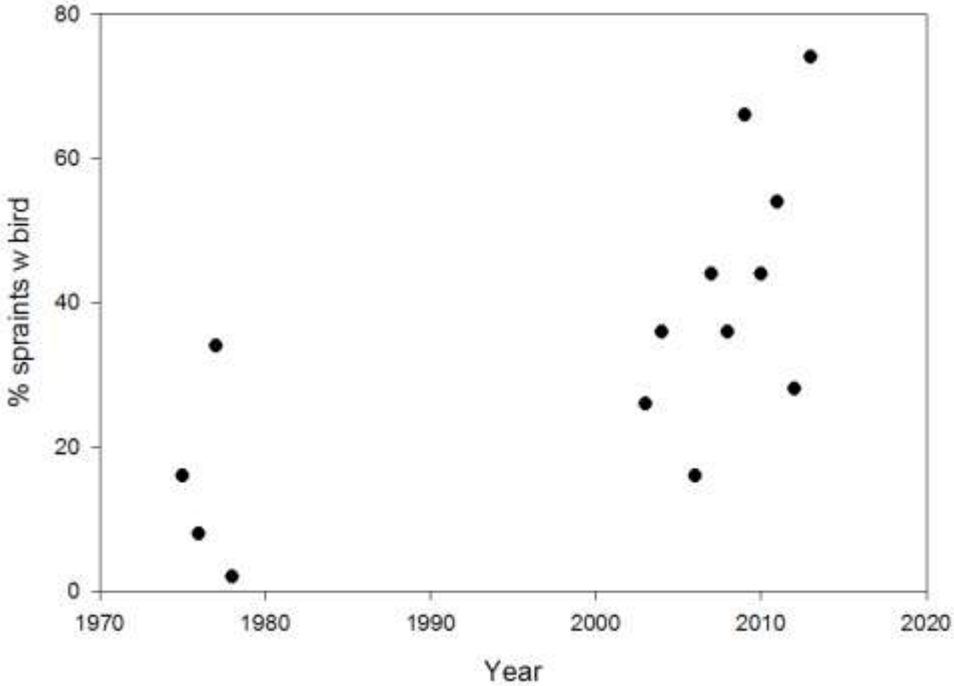

Figure 5. Remains in spraints of birds (almost all juveniles), 2003-2013. Spearman rs=0.745 n=14 $P<0.01$

Amphibians taken by otters in the Dinnet lochs were almost all frogs, and very few toads, despite the latter's abundance (Weber, 1990). There was no significant long-term trend in the occurrence of amphibians in the otter diet, but considerable variation over the years (Fig. 6).

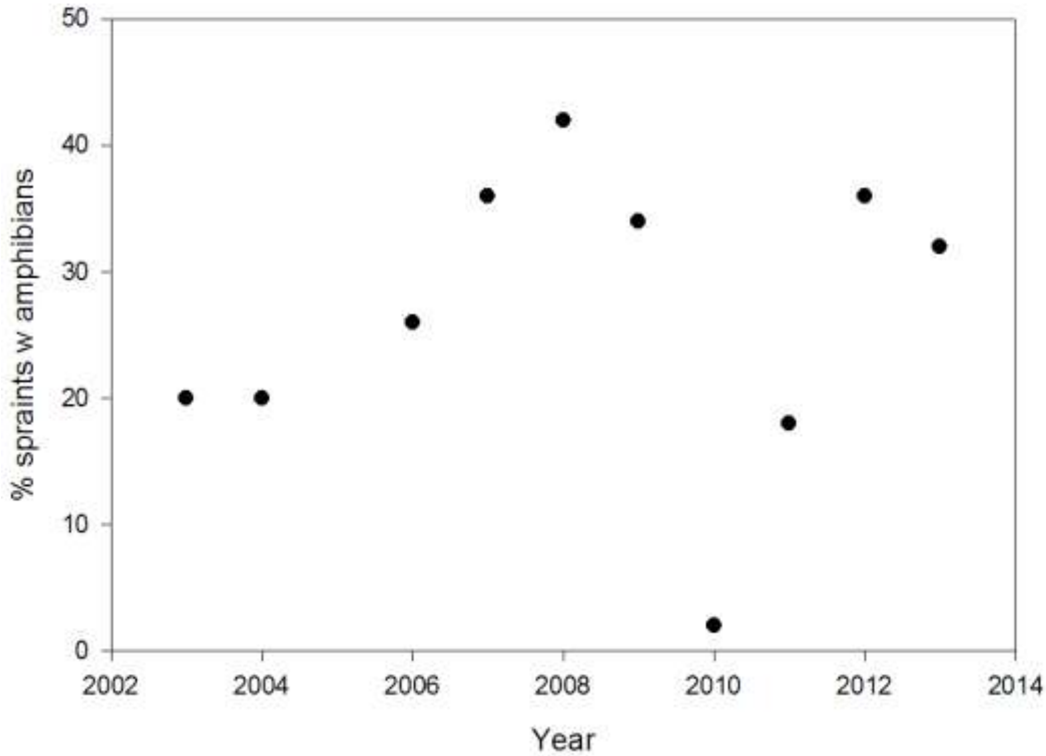

Figure 6. Amphibians in Dinnet spraints, June 2003-2013. Spearman rs=0.157 n=10 *P*>0.05.

During the study period few mammals were taken by otters. This in contrast with the 1970s when they played an important role (Jenkins and Harper, 1980), but during the period 2003-2013 there was no obvious trend.

DISCUSSION

The declining numbers of otters in visual observation in the Dinnet lochs suggest a declining population, but one has to be mindful of the possibility of an increase in nocturnality of otters, with the decline of eel. Otters have been shown to be active especially at those times of day when their main prey species are inactive, as in Shetland (Kruuk et al., 1988). In the case of eels this is daytime. However, the few simultaneous observations of otter trails in reed beds, couches and numbers of spraint sites and spraints suggested that the lack of direct observations of otters was, indeed, largely due to their complete absence, rather than to their behaviour.

Results of otter faecal analyses have to be interpreted with care, because of the many hazards involved in spraint-data interpretation, which is plagued by large species- and size-specific biases (Carss and Parkinson, 1996, Carss and Elston, 1996). However, whatever the biases involved, the above results should be comparable between years and the trends shown in the above results should be reliable. There were significant declines in the otters' use of eels as prey, and increases in the use of especially birds, but also of other fishes.

Eels have a higher calorific value than most other prey. Eels taken by otters were smaller at the end of the study period than earlier, and it has been demonstrated that small eels are calorifically less valuable to predators than are large ones (Nelson and Kruuk, 1997): the calorific content per gram of a 300g eel is more than 1½ x that of a 200g eel. Thus, our observations suggest a strong decline in energetic profitability of otter fishing, which is likely to have consequences for the population. It was predicted earlier that, at the present level of fishing profitability, otters would not be able to sustain numbers and reproduction (Kruuk, 2006). This study suggests that the Dinnet lochs have now reached that point.

Thus, the apparent changes in otter numbers in Dinnet are paralleled by a decline in their consumption of eel. There are no recent data on changes in the eel numbers in Dinnet itself, but the nearby Girnock Burn, a tributary to the River Dee, a decline of 50% was recorded over the last 30 years (ICES 2012). In Britain, and indeed worldwide, eel numbers show a spectacular decline, with recruitment in the 1990s a mere 1% of what is was in 1980 (Stone, 2003). There is a clear possibility of extinction in the next few decades. It is likely that these changes in eel numbers are paralleled in the Dinnet population.

Occurrence of ‘other fish’ in spraints increased significantly. However, within each spraint each of those other species usually showed only a minor presence, with only a few small vertebrae or small scales, and overall these ‘others’ were always of minor significance, as were invertebrates. The consumption of salmonids suggested that otters had been foraging in feeder streams or outlets of the lochs.

Effects of changes in otter diet on numbers of water birds are difficult to evaluate. Clearly there was a very steep increase in predation on birds per otter, especially after 2003, and remains of birds usually dominated entire spraints. However, the decline in otter numbers would have an opposite effect on overall predation. Numbers of ducklings of mallard (*Anas platyrhynchos*), widgeon (*A. penelope*) and tufted duck (*Aythya fuligula*) have declined in Dinnet over the last few years of the study period (H. Scott, pers. comm.). The long-term decline in mammals in the otter diet corresponds to a conspicuous decline of rabbits (*Oryctolagus cuniculus*) in and around the study area and elsewhere (unpubl. observations).

The profound ecological changes, in the Dinnet lochs over the last two decades, are of special conservation concern especially because of the apparent severe decline in otter numbers. Such changes in otter numbers are not likely to be detected in the national otter surveys in Britain, as these are based on the presence/absence of spraints, a measure which is not sensitive to changes in actual otter numbers (Kruuk, 2006).

If otter numbers are limited by food supply, as suggested from studies elsewhere and from the otters’ energetics (Kruuk et al., 1993, 1994; Kruuk and Carss, 1996; Kruuk, 2006), and if eel numbers in the lochs are or were of major importance to otters, then the changes in numbers of eels in the otter diet over the last decade provide a likely hypothesis for the steep decline in otter numbers and otter reproduction in Dinnet. One could argue that these declines have been detected in only this one study area, and may not be nationally representative. However, this is one of the longest and most intensive otter studies in Britain, and the decline in eel populations is probably nationwide (Stone, 2003). The present results, therefore, could well flag a national trend in otter numbers where eels were common, and should be of serious concern to conservationists.

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RÉSUMÉ

LOUTRES ET ANGUILLES: DÉCLIN EN ECOSSE

Le régime alimentaire estival des loutres *Lutra lutra* a été étudié pendant presque 40 ans dans une zone au nord est de l'Ecosse. Depuis 2000, la population de loutres et leur succès reproducteur ont décliné. Simultanément l'occurrence des anguilles (*Anguilla anguilla*) dans les épreintes, initialement la proie principale des loutres, a diminué substantiellement. Ceci est considéré comme le reflet d'un net déclin global des anguilles.

La prédation des loutres sur les jeunes oiseaux dans la zone d'étude a augmenté ainsi que la prédation sur d'autres espèces de poisson, de même que l'importance relative des autres proies. Il est probable qu'avec cette restriction alimentaire chez les loutres, le déclin des anguilles représente un réel problème pour la conservation des loutres.

RESUMEN

NUTRIAS Y ANGUILAS: OBSERVACIONES DE LARGO PLAZO SOBRE DECLINACIONES EN ESCOCIA

Se ha monitoreado la dieta estival de nutrias *Lutra lutra*, por casi cuarenta años en un área de estudio en el NE de Escocia. Desde el 2000, la abundancia y reproducción de las nutrias en el área han declinado. Al mismo tiempo, disminuyó sustancialmente la ocurrencia de anguilas (*Anguilla anguilla*) en las fecas de nutrias; las anguilas eran anteriormente la presa dominante de las nutrias. Subyacente, hay una aguda declinación -bien documentada, en la abundancia de anguilas, y que probablemente sea global. En el área de estudio aumentó la predación de las nutrias sobre las aves acuáticas, así como sobre otras especies de peces, y también se documentan cambios en la importancia de otras presas. Se sugiere que al estar las nutrias limitadas por alimento, la declinación de las anguilas debería ser una seria preocupación para los involucrados en la conservación de las nutrias.

S H O R T N O T E

SPRAINTING INTO THE WIND

Hans KRUUK

(Received 23rd November 2013, accepted 26th November 2013)

Abstract: Otters *Lutra lutra* deposited scent-marks (*spraints*) along a small stream in Scotland. The large majority of spraints was found on the bank upwind of the stream, whereas remains of frogs eaten by the otters were found on either bank, showing that otters used both banks equally, but wind-direction was a factor in selection of one bank for scent marks.
Keywords: otter; *Lutra lutra*; communication; frog predation

INTRODUCTION

Otters (*Lutra lutra*) are probably unique amongst Carnivora in the number of defaecations (*spraints*) they regularly produce per day, more than 30 (Kruuk, 1992, 2006). This refers to the number of spraints one sees being deposited when watching the animals in the wild, but otters also often defaecate when swimming, bending the tail above the surface. An explanation for the high frequency of sprainting on land is the role spraints play as scent marks, apart from the obvious role of elimination of faeces.

The scent-marking role is evident when watching otters' behaviour to spraints from other otters (approaching, sniffing, over-marking, etc.), and also from the conspicuousness of the locations where spraints are deposited. Such aspects of scent-marking with faeces are common amongst carnivores (Gorman and Trowbridge 1989). For instance, I noticed that spotted hyaenas (*Crocuta crocuta*), a species that habitually follows paths and roads in its range, defaecate in their latrines which are located significantly more often on the upwind side of tracks rather than downwind, in their windy, open habitat in the Chalby Desert in northern Kenya, where winds tend to come mostly from one direction (unpubl. obs.). This behaviour makes sense if faeces have a role in communication. The present paper investigates whether otters show comparable behaviour.

The opportunity to study the effect of wind-direction on sprainting behaviour presented itself in Scotland in an area where otters used a kilometers long, straight artificial stream in open country. Otters used the stream when travelling between a marsh and a small river, and they sprainted on its banks. Also, otters foraged for common frogs (*Rana temporaria*) in the stream, and when they caught a frog, climbed onto one of the banks to dismember and consume it. In order to study whether wind direction influenced the location of spraint sites, I compared on which side of the stream I found spraints, and remains of frogs.

STUDY AREA AND METHODS

Observations were made during 9 visits in January and February in 2007, 2008 and 2011. Observation sites were along 2km of the Gellan Burn (Ordinance Survey end-points NJ488021 to NJ506017), running from approx. WNW, 280° to ESE, 100°. It is straight with only two slight bends, rarely wider than 1m or deeper than 0.5m. In this area the prevailing wind direction is very predominantly SW, therefore the south bank of the stream is upwind, for any animal swimming. The banks are sloping, 1-2m high, exposed, covered in mostly grass or rushes, with very few trees, shrubs or other obstacles, through open, flat country. The vegetation on either side of the stream was similar (Fig. 1).

Figure 1. Study site at the Gellan Burn

Otters are quite frequently seen along the stream, males as well as females with or without cubs, but their numbers are unknown. They defaecated, sprainted, either on established sites were other spraints were or had been present, or more commonly just anywhere on the bank, near grass clumps, on stones or on small rises.

Common frogs are abundant and they winter in the bottom of the stream where otters catch them in winter or early spring, taking the prey up the bank to eat it. When an otter consumes a female frog during that season, it almost always leaves a conspicuous, quite large clump of white jelly, the remains of the frog’s egg clump. Occasionally other predators catch frogs here (grey heron *Ardea cinerea,* buzard *Buteo buteo*, fox *Vulpes vulpes*), but they either consume the frogs’ egg-jelly, or leave it a long way from the water (pers. obs.). I assume, therefore, that frog-jellies left along the stream are remains of otter prey.

During every visit all spraints and frog jellies were noted, whether south or north of the stream, and spraints and jellies were removed to prevent double-counting in subsequent visits.

RESULTS

There was a highly significant difference in the north-south distribution of spraints and jellies (Table 1): if an otter caught a frog, it would climb the bank on either side of the stream to eat it, but if it was about to deposit a spraint, it would climb the south bank five times more often than the north bank.

Table 1. Numbers of spraints and frogs' egg-jellies per visit, along the banks of the Gellan Burn, January-February 2007, 2008 and 2011.

	Spraints								Frog Jellies							
North Bank	0	0	1	8	4	0	2	2	2	4	3	14	6	8	2	0
						Total	=	**17**						**Total**	=	**39**
South Bank	18	5	5	16	20	6	11	4	0	6	2	13	8	6	3	2
						Total	=	**85**						**Total**	=	**40**

For the difference in distribution along N and S banks χ^2= 207.8, df=1, P<0.001.

The south bank was upwind of the otter when it coursed along the stream, and there were no other obvious differences between the two banks in vegetation or other environmental variables.

DISCUSSION

The results suggested clearly that otters had no preference for either stream bank for feeding purposes, but significantly preferred the upwind bank for sprainting. It was not possible to investigate whether in this preference otters were reacting to previous spraints or spraint sites, or only to the wind direction, or to both, although to some extent this is immaterial. The results strongly suggest that, either in the past when spraint stations were established, or immediately preceding my observations, otters did take wind direction into account when sprainting. The finding confirms the importance of spraints in scent communication between individual otters; it also might have a practical use for research, when searching for spraints along river banks in open country.

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RÉSUMÉ

EPREINTES DANS LE VENT

Les loutres *Lutra lutra* déposent leurs épreintes le long d'un petit cours d'eau en Ecosse. La majorité des épreintes sont trouvées sur la rive au vent du ruisseau, alors que les restants des grenouilles consommées par les loutres sont répartis sur les deux rives, montrant que les loutres utilisent également les deux rives dans ce cas, mais que le sens duvent influe sur le choix d'une rive pour déposer leurs épreintes.

RESUMEN

MARCANDO EN EL VIENTO

Las nutrias *Lutra lutra* depositaron marcas olorosas (*spraints*) a lo largo de un pequeño arroyo en Escocia. La gran mayoría de *spraints* fue encontrada en la barranca contra el viento, mientras que los restos de ranas comidas por las nutrias fueron encontrados en ambas barrancas, mostrando que las nutrias usaron ambas barrancas igualmente, pero la dirección del viento fue un factor que influyó en la selección de una barranca para dejar las marcas olorosas.

ARTICLE

PREY PREFERENCE OF THE NORTH AMERICAN RIVER OTTER (*Lontra canadensis*) EVALUATED BASED ON OPTIMAL FORAGING THEORY

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Abstract: Prey preference of the North American river otter (*Lontra canadensis*) was studied in a captive population and evaluated according to optimal foraging theory. Live sunfish (*Lepomis* spp.), brown trout (*Salmo trutta*), and crayfish (*Cambaridae* spp.) were released in a pool, and the search, chase, and handling/eating times of two otters were recorded. When provided with choice of sizes, otters showed a significant preference for catching and eating large prey first. When given a choice of species, otters significantly preferred to catch and eat brown trout first; this preference remained when offered dead prey. Using the rate of energy intake, the preference for brown trout was expected as it provided significantly more energy per unit time, but size preferences only fit predictions after metabolic rate was incorporated, as an otter expends more energy chasing prey in the water than when eating on land. The net energy gained was significantly greatest for large prey in all the size trials and for brown trout in the species trials. Captive river otters exhibit prey preferences that match our predictions based on optimal foraging theory, which can provide insight into dietary habits of wild otter populations.

Keywords: aquatic mammal, energetics, otter diet, captive research

INTRODUCTION

North American river otters (*Lontra canadensis*) inhabit a wide variety of habitats in freshwater (wetland, river, and lakes) and coastal marine environments (IUCN Red List, 2013). They are adapted for hunting in the water (Fish, 1994) and are often labelled as opportunistic predators since their preference depends on availability of prey. Fish are considered the primary source of food (Hamilton, 1961; Melquist and Hornocker, 1983; Skyer, 2006); yet, crayfish are important prey when available (Sheldon and Toll, 1964; Griess, 1987; Manning, 1990), which is usually during the summer months. Otters have also been known to eat reptiles, amphibians, birds, aquatic insects, small mammals, and molluscs (Greer, 1955; Hamilton, 1961; Knudsen and Hale, 1968).

Prey speed and size are expected to influence predation by river otters. Most researchers have found that slow-moving fish were preferred over game fish (Hamilton, 1961; Sheldon and Toll, 1964; Knudsen and Hale, 1968; Serfass et al., 1990; Cote et al., 2008), although some have found game fish such as trout, bass, and whitefish to be more important (Greer, 1955; Melquist and Hornocker, 1983). One study of Eurasian otters (*Lutra lutra*) in captivity observed that the animals had difficulty catching prey that was smaller than 10 cm, attributing the preference for larger prey to their greater visibility to the otters (Erlinge, 1968). However prey sizes in the diets of North American river otters in the wild ranges from 2 to 71 cm (Melquist and Hornocker, 1983; Stearns and Serfass, 2011). Cote et al. (2008) found that minimum prey size varied with the species of fish, which may be due to differences in their camouflage and behaviour.

Optimality models are used to predict how an animal will behave based on the assumption that the trade-off between costs and benefits leads to the evolution of behaviors that provide the maximum gain to the organism (Krebs and Davies, 1993). Optimal foraging theory can provide an explanation of prey preferences based on a diet that would maximize their caloric intake and minimize foraging energetic costs (Emlen, 1966; MacArthur and Pianka, 1966; Alcock, 2001). Early models of optimal foraging theory by Emlen (1966) focused on the energetics of prey choice in relation to availability while MacArthur and Pianka (1966) incorporated the patchiness of prey distribution. A number of studies showed that optimal foraging theory applies to foraging behavior in aquatic mammals. Bowen et al. (2002) studied harbor seal (*Phoca vitulina*) foraging and found that the time spent chasing and handling prey, along with the associated energetic cost, differed significantly between prey items; the net energy gained increased with increasing prey size. Ford and Ellis (2006) showed that resident killer whales (*Orcinus orca*) selectively foraged for large, high fat content, and available year-round prey.

North American river otter populations had declined by the early 1900’s due to trapping, incidental mortality, loss of suitable habitat, and pollution (Boyle, 2006). Fortunately, improvements in water quality and furbearer management techniques led to recolonization in many areas so that the species is now considered to be “Least Concern” (IUCN Red List, 2013). There have also been numerous reintroductions throughout the United States to restore populations (Raesly, 2001), but this raises concerns from fishermen that their game fish may be depleted by the otters (Serfass et al., 1990, Hoffman and Genoways, 2005).

The goal of this study was to learn the prey preference of the North American river otter and to assess if their preference follows the predictions of optimal foraging theory. We offered river otters a limited choice of sizes and prey species, predicting they would select the prey that provided the greatest caloric content per unit of foraging and handling time. By examining captive river otters, more can be understood about how these predators choose their prey and how availability of prey may impact their foraging behavior. This will allow managers to identify suitable habitat containing appropriate sizes and types of prey, which will help to protect both otter and fish populations.

ANIMALS, MATERIALS AND METHODS

Captive feeding experiments were conducted at the Seneca Park Zoo in Rochester, New York, USA from 26 June 2006 to 11 January 2007. Three river otters were part of the permanent collection: Darla (10 year old female), Nosey (16 year old male), and Admiral (17 year old male); Nosey was not used in the study as he is almost completely blind due to cataracts and unable to catch live prey. The otters were born in the wild (from Louisiana and South Dakota) and occasionally offered live fish at the zoo for enrichment, thus they had prior experience hunting and feeding on live prey. The exhibit includes an 11,670 gal oval pool which is 9.14 m long, 3.05 m wide at the north end and 1.83 m wide at the south end, ranging from 1.22 to 2.44 m deep. One small tube (~5 cm in diameter) was located at the lower right side of the pool and on occasion was used to deliver live feeding enrichments by the zoo staff. All trials were conducted between 0800 and 1000 hours before the zoo opened to the general public to avoid distractions from visitors. The otters' morning meal of dead smelt, mackerel and capelin was withheld to ensure they would be hungry, but they were fed their regular meals of dry dog food and Natural Balance Zoo Carnivore Diet in the afternoon.

Prey options were based on the diet of local river otters (Skyer, 2006) and were intended to provide a range of mobility and crypsis: slow-moving sunfish (*Lepomis spp.*), fast-moving brown trout (*Salmo trutta*), and camouflaged crayfish (*Cambaridae spp.*). Three experimental trials were conducted: size trials (n = 20: 6 trout, 7 sunfish, 7 crayfish), live species trials (n = 6), and dead species trials (n = 12). To determine if there is a preference for a prey size, one small, one medium, and one large live prey of the same species were released into the pool (size trials). To determine if there is a preference for a prey species, one of each of the prey types of the same size was released (live species trials). To determine if the species preference changed if the otter did not have to catch the prey, the dead species trials used the same three prey types, but they were thawed and lined up in a random order on the floor of their holding pens directly across from their access point, before the otters were allowed to enter. In all trials, only one otter was in the exhibit pool or in a holding pen at a time, and before the start of each live trial, prey were allowed a few minutes to acclimate to the pool.

Prey was obtained from suppliers or caught locally, and maintained in the lab for less than a month before experimental trials. Each prey item was weighed with an Acculab V-200 scale (0.01 g accuracy), measured with a meter stick, and then classified into three relative size groups (Table 1). Lengths and masses of the three size classes were compared by ANOVA and differed significantly for each of the species (sunfish size trials -- length: F = 118.95, P<0.001, df = 2 and weight: F = 53.84, P<0.001, df = 2; crayfish size trials - length: F = 4.88, P = 0.018, df = 2 and weight: F = 10.68, P=0.001, df = 2; brown trout size trials -- length: F = 308.81, P<0.001, df = 2 and weight: F = 500.54, P<0.001, df = 2). For the species trials, medium fish and the largest available crayfish were used to try and offer the same sized prey but the crayfish were still significantly smaller in length than the brown trout and sunfish; there was also a significant difference between the masses of all three species with sunfish weighing the highest, trout were intermediate, and crayfish were the lowest weight (live species trials -- length: F = 19.90, P<0.001, df = 2, weight: F = 46.03, P<0.001, df = 2.; dead species trials -- length: F = 45.12, P<0.001, weight: F = 88.72, P<0.001, df = 2).

Trials were filmed with a digital camcorder (Canon Elura 90) from an underwater viewing area with a window 7.04 m wide by 2.16 m tall into the pool. Video records (11.4 hours) were later analyzed and the following variables measured: Search time (S) - start of a successful dive from the surface to when the otter saw a prey item, Chase time (C) - end of the search time until the otter firmly caught the prey by biting into it, Handling/eating time (F) – end of the chase time until the prey was consumed. Since medium sunfish and brown trout sizes used in both size and species trials were not significantly different, the time data for medium fish in size trials were combined with the respective time data from species trials to increase those data sets. Observations were recorded including which prey item was caught and eaten first, time spent in the water and on land, along with any other notable behaviors. Swim speed was calculated using a metric measuring tape placed parallel to the surface of the water along the glass window and the time it took for an otter to swim a measured distance was recorded.

Table 1. Average sizes (± standard deviations) of prey offered to river otters in both the size and the species trials. Brown trout size trials -- small: *N*=6, medium: *N*=17, large: *N*=6. Crayfish size trials: small: *N*=9, medium: *N*=9, large: *N*=7. Sunfish size trials: small: *N*=13, medium: *N*=25, large: *N*=9. Live species trials -- brown trout: *N*= 17, sunfish: *N*=25, crayfish: *N*=6. Dead species trials -- *N*=12 for all species.

Trials	Size	Brown Trout	Crayfish	Sunfish
Small	Length (cm)	7.75 ± 1.24	6.78 ± 2.56	10.95 ± 0.46
	Mass (g)	4.63 ± 2.19	3.41 ± 2.78	21.43 ± 4.75
Medium	Length (cm)	12.95 ± 0.88	8.26 ± 2.42	13.01 ± 0.64
	Mass (g)	28.91 ± 5.87	6.33 ± 3.12	37.29 ± 5.77
Large	Length (cm)	20.83 ± 1.31	9.80 ± 2.56	14.88 ± 0.64
	Mass (g)	101.40 ± 11.42	10.89 ± 3.82	58.21 ± 15.30
Live species	Length (cm)	12.95 ± 0.88	11.12 ± 0.35	13.01 ± 0.64
	Mass (g)	28.91 ± 5.87	13.24 ± 0.16	37.29 ± 5.77
Dead species	Length (cm)	12.75 ± 0.69	10.64 ± 0.72	12.95 ± 0.57
	Mass (g)	28.53 ± 6.39	10.99 ± 3.64	39.00 ± 5.21

To determine if the otters were feeding optimally, the rate of caloric intake (R) in Calories per second was calculated for each prey size and species in the different trials; R = E/H where E is the amount of energy (in Calories, e.g. Kcal) in a prey item and H is the time (in seconds) it takes to chase, handle, and eat the prey item (Stephens and Krebs, 1986; Kruuk, 2006). The search time was not included as it was not comparable between trials due to the variation in prey location and otter positioning. Prey energy values were calculated by multiplying the average mass for each size class with energy content based on published literature: brown trout = 1.45 Cal g^{-1} (Berg et al., 1998), sunfish = 0.89 Cal g^{-1}, and crayfish = 0.72 Cal g^{-1} (U.S. Department of Agriculture, 2006).

Estimates of metabolic costs while foraging were also incorporated. The energy cost in Calories of searching for, chasing, handling, and eating each prey item was calculated by:

$$\text{Cost} = [(MR_W * (S+C)) + (MR_W * F * \%F_W) + (MR_L * F * \%F_L)] * \text{Mass}/\ 4186.8\ \text{J/Cal}$$

MR_L (4.1 W kg^{-1}) is the estimated metabolic rate of resting on land, and MR_W (11.6 W kg^{-1}) is the average rate while swimming for European river otters, *Lutra lutra* (Pfeiffer and Culik, 1998). Although metabolic rates have not been studied in *L. canadensis*, Kruuk (2006) asserts they have a similar high metabolism as *L. lutra*. The average percent of handling and eating time spent in the water ($\%F_W$) and the average percent of handling and eating time spent on land ($\%F_L$) was measured from the video records. A value of 10 kg was used for mass as these otters ranged in weight from 9.05 kg to 10.1 kg throughout the study. Search time was included in this calculation since an otter could face similar variance of prey location in a stream as it would in our captive experiment pool and this value is an estimate of the true energetic costs of foraging. Net energy gained (in Cal) was calculated by subtracting the energy cost of capturing and consuming prey from the energy available in the prey.

Statistical analyses of the data were performed using Minitab 9 software (Minitab Inc, State College, Pennsylvania, USA) with $\alpha = 0.05$. An Equal Variances test showed that not all variances were equal, so the time data was ranked and a General Linear Test was performed on the ranked data to determine if there was a significant difference between the time spent on foraging activities and energetics values with prey size or with species. We pooled multiple trials from each of the two otters so included otter identity as a factor to determine if there were individual differences, hereafter referred to as an otter effect. All significant differences were further examined with Tukey post-hoc comparisons. A One-Proportion test was used to assess if there was a preference in which prey was caught or eaten first.

RESULTS

Size trials

For brown trout, the time otters spent chasing, handling, and eating (H value; Table 2) was significantly different between all size classes ($F = 38.62$, $P<0.001$). Although the energy content increased significantly with each size class ($F = 71.34$, $P<0.001$) there was no significant difference in rates of caloric intake (R values) between sizes ($F = 2.12$, $P=0.151$). Large trout required a significantly greater energy cost to chase, handle, and consume ($F = 49.35$, $P<0.001$; Figure 1a), but provided the greatest net energy gain ($F = 49.35$, $P<0.001$). There was a significant preference for large brown trout as the otters caught the large prey first in six out of seven trials ($P=0.006$; Fig. 2) and the large was always eaten first ($P<0.001$). In one trial, a medium trout was caught first and left on the bank, but then a large was caught and immediately consumed.

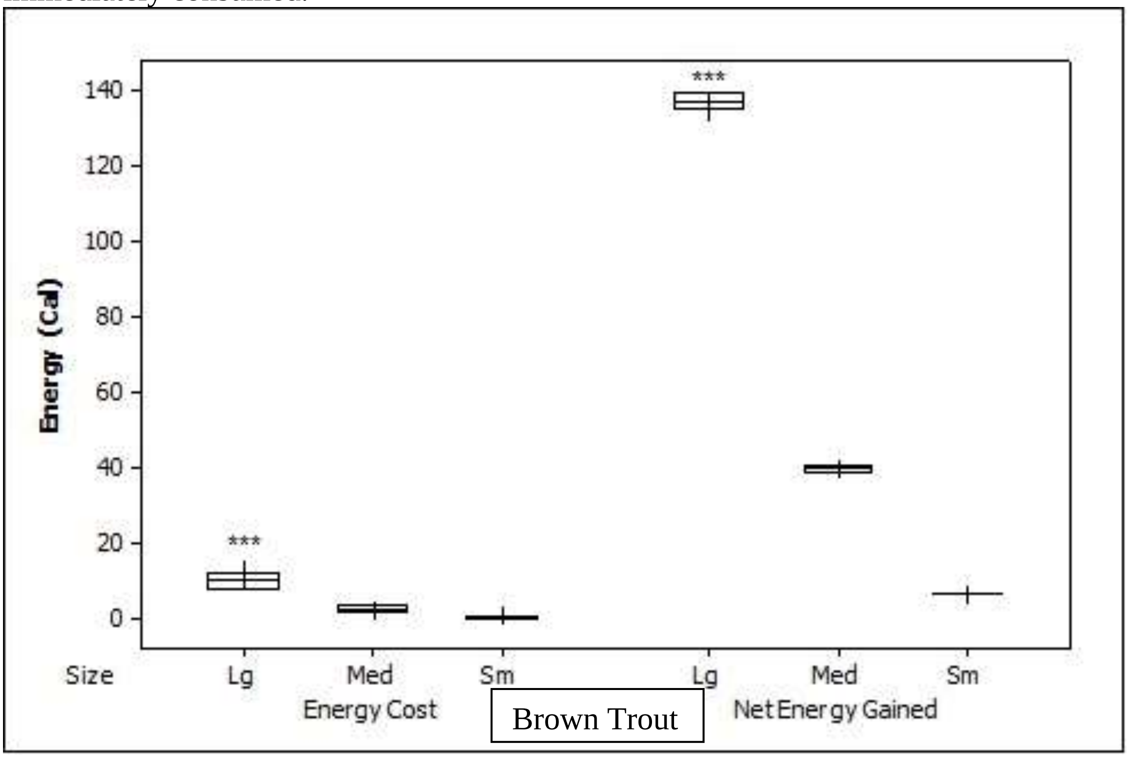

Figure 1 a)

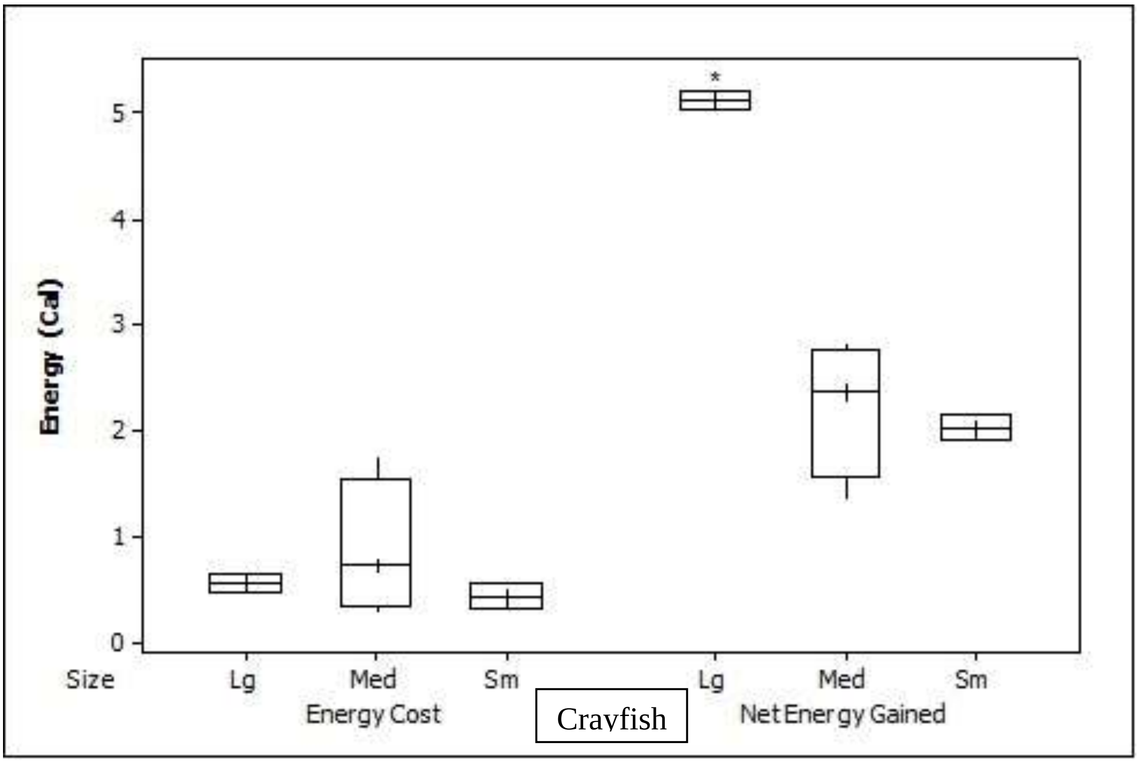

Figure 1b)

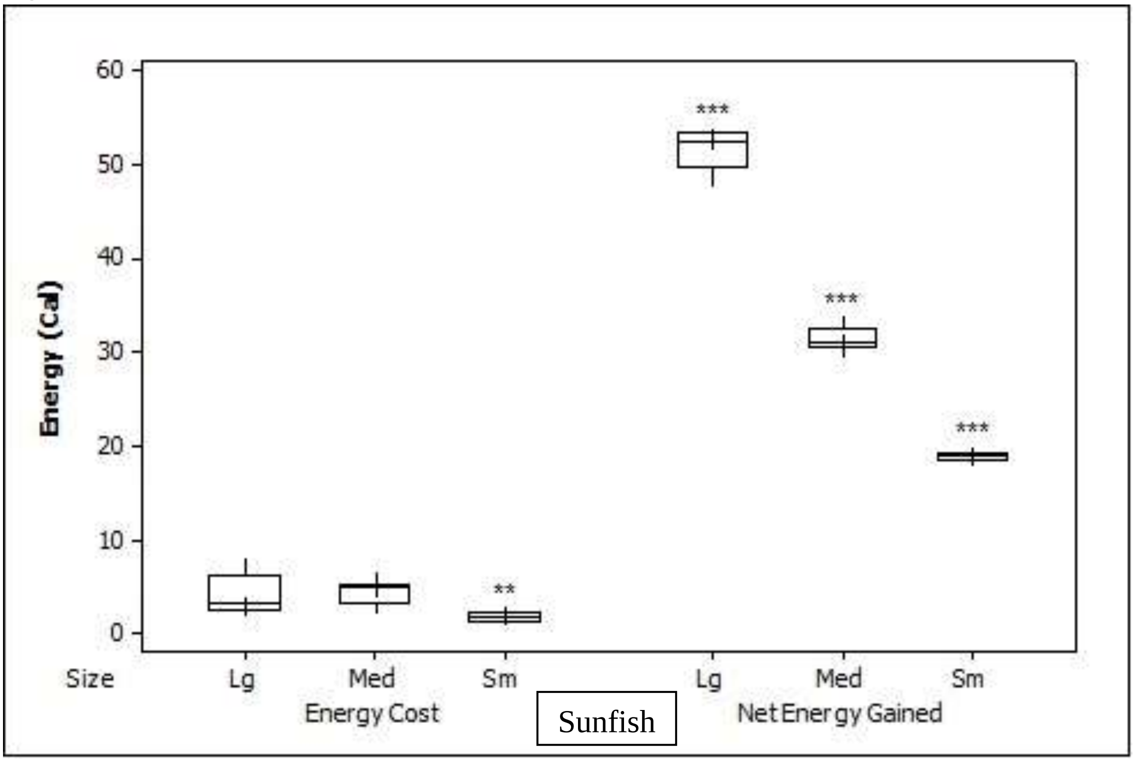

Figure 1c)

Figure 1. Energetics of size trials: small, medium and large sized live prey were offered to the otters in their pool. Energy cost was calculated based on the otters' metabolic rates multiplied by time spent in water vs. time on land for each size prey; net energy gained was calculated by subtracting the cost from the energy available in each size prey. a) Brown trout, b) Crayfish, c) Sunfish. Asterisks denote statistical significance at $P \leq 0.05$*, $P \leq 0.01$**, $P \leq 0.001$***

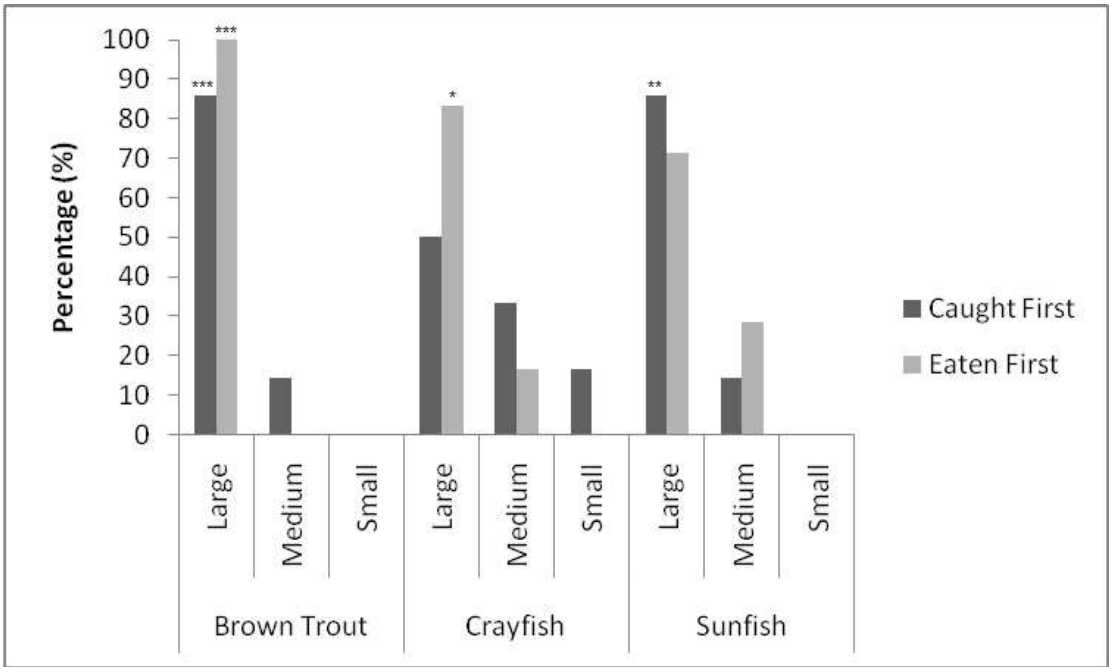

Figure 2. Otters preferences when offered three sizes of each live prey species during size trials, based on the percentage of each that they caught or consumed first. Brown trout N=6, Crayfish N=6, Sunfish N= 7. Asterisks denote statistical significance at *P*≤0.05*, *P*≤0.01**, *P*≤0.001***

For crayfish, the time spent chasing, handling, and eating (H value) was significantly related to size (Table 2) being higher for the large than the medium (F = 12.50, P=0.011) (small crayfish were not included in this analysis as four individuals were caught but only one was consumed so standard deviation could not be calculated). The large crayfish contained a significantly greater energy content than the small (F = 9.26, P=0.001). Although the large crayfish provide the highest rate of caloric intake (R value), it was marginally not significant (F = 5.35, P=0.057). There was no difference in the energy cost (F = 0.75, P=0.512), but the large crayfish provided a significantly greater net energy gain (F = 7.91, P=0.021; Figure 1b). There was also no significant difference in which size they caught first (P=0.671; Fig. 2) as the large crayfish was caught first three out of six times. Yet, if the otter saw a large crayfish after catching a smaller size, it would drop it on land, then catch and consume the large one first before consuming the previously caught crayfish. Thus, there was a significant preference for the large crayfish as they ate the large ones first five out of six times (P=0.017).

Small sunfish required significantly less time to chase, handle and eat (H value) (F = 5.93, P=0.011; Table 2), but there were no differences between the medium and the large sunfish (T = 0.487, P=0.878). The large sunfish contained significantly more prey energy, followed by medium and small (F = 53.81, P<0.001). The rate of caloric intake (R value) was significantly lower for the medium sunfish (F = 3.63, P=0.048). Small sunfish cost significantly less energy (P=0.003; Figure 1c), but the large provided the greatest net energy gain, followed by the medium, and small (F = 56.21, P<0.001). The large sunfish were caught first six out of seven trials (P=0.006; Figure 2), but the large was only eaten first five out of seven trials since in one trial a large was caught and left on the bank, then a medium was caught and eaten before the large fish. Thus there was no significant difference in which size sunfish was eaten first (P=0.104).

Table 2. Foraging times and associated energetic benefits, in terms of prey caloric content. For size trials, otters were offered three live prey items of different sizes but only one species at a time, while in species trials, otters were offered one of each prey type of similar size, in both live trials and dead trials. All values are means (± standard deviations), N = sample size (sample sizes differed when the otters either did not find or refused to eat some of the prey choices). Statistical comparison were only conducted for the H, E, and R values since they incorporate the other variables; except for the dead trials, handling & eating was compared since there was no H value. Asterisks denote statistical significance at $P \leq 0.05$*, $P \leq 0.01$**, $P \leq 0.001$***.

Prey species	Trial type	Prey type	Search (s)	Chase (s)	Handling & eating (s)	Chasing, handing, & eating (s) =“H”	Energy (Cal) = “E”	R (Cal/s) = “E/H”
Brown trout	Size	Small (N=6)	3.00 ± 4.64	6.00 ± 6.82	13.00 ± 4.06	19.00 ± 9.72***	6.31 ± 5.42***	0.33 ± 0.46
		Med (N=12)	6.50 ± 5.32	26.08 ± 13.96	92.42 ± 52.87	116.83 ± 34.83***	49.75 ± 4.06***	0.42 ± 0.17
		Large (N=6)	4.50 ± 3.27	27.33 ± 16.78	575.67 ± 189.18	603.00 ± 180.14***	147.67 ± 27.51***	0.24 ± 0.06
	Species	Live (N=12)	6.50 ± 5.32	26.08 ± 13.96	92.42 ± 52.87	116.83 ± 34.83***	49.75 ± 3.06	0.42 ± 0.17***
		Dead (N=12)	NA	NA	12.33 ± 3.42	NA	45.14 ± 4.42	3.66 ± 1.10***
Crayfish	Size	Small (N=4)	7.50 ± 2.08	2.25 ± 1.71	8.00	10.00	2.44 ± 3.61	0.24 ± 0.07
		Med (N=7)	16.86 ± 18.23	3.86 ± 1.86	8.25 ± 1.89	12.75 ± 1.71	3.49 ± 3.96	0.27 ± 0.03
		Large (N=6)	4.00 ± 2.61	6.00 ± 2.83	12.00 ± 2.00	19.33 ± 2.08*	6.53 ± 4.63**	0.34 ± 0.03
	Species	Live (N=6)	14.00 ± 7.87	7.33 ± 4.22	51.17 ± 30.39	58.50 ± 34.17***	9.49 ± 0.17***	0.16 ± 0.09
		Dead (N=4)	NA	NA	12.33 ± 9.81	NA	8.43 ± 0.95***	0.68 ± 0.61
Sunfish	Size	Small (N=5)	12.40 ± 10.52	11.60 ± 6.50	66.00 ± 25.98	77.00 ± 28.74*	19.29 ± 6.43***	0.25 ± 0.10
		Med (N=12)	8.00 ± 5.75	25.00 ± 17.77	232.00 ± 87.66	257.00 ± 93.58	34.39 ± 9.15***	0.13 ± 0.06*
		Large (N=7)	7.00 ± 2.14	24.00 ± 9.66	210.00 ± 135.70	237.00 ± 144.62	53.50 ± 14.23***	0.23 ± 0.18
	Species	Live (N=12)	8.00 ± 5.75	25.00 ± 17.77	232.00 ± 87.66	257.00 ±93.58***	34.39 ± 9.15	0.13 ± 0.07
		Dead (N=4)	NA	NA	135.00 ± 10.61***	NA	35.64 ± 4.39	0.26 ± 0.02

Species trials

When all three prey types were offered together in the live species trials, otters spent significantly longest chasing, handling, eating sunfish (H value), followed by trout and then crayfish (F = 23.40, P<0.001; Table 2). Both brown trout and sunfish contained significantly more prey energy than the crayfish (F = 13.15, P<0.001). The rate of caloric intake (R value) was significantly larger for the brown trout than for the sunfish or the crayfish (F = 21.20, P<0.001). The sunfish had a significantly higher energy cost than the brown trout or crayfish (F = 12.72, P<0.001; Figure 3a), and yielded less net energy than trout but more net energy than crayfish (F = 86.47, P<0.001). The otters displayed a significant preference for brown trout as they were caught first five out of six times (P=0.017; Figure 4) and were always eaten first (P=0.001), since in one trial, a sunfish was caught first, but was abandoned on the bank when the otter went back into the water to catch a brown trout and consumed it first.

When otters were offered dead prey, it took them significantly longer to handle and eat the sunfish (F = 13.72, P=0.001; Table 2), but there was no significant difference between crayfish and brown trout (T=2.246; P=0.098). There was also a significant difference between individual otters in how long it took each to handle and consume the dead prey, e.g. an "otter effect" (F = 8.77, P=0.010). Both brown trout and sunfish contained significantly more prey energy than crayfish (F = 39.58, P<0.001). The brown trout provided the significantly largest rate of caloric intake (R value) (F = 17.40, P<0.001), and there was a significant otter effect (F = 40.32, P<0.001). The sunfish required a significantly larger energy cost (F = 6.16, P=0.011; Figure 3b), while the brown trout provided a significantly greater net energy gain (F = 17.46, P<0.001). Both otters selected the brown trout first in all twelve dead trials (P<0.001, Figure 4). They differed though in their second choice; the sunfish were usually eaten next by Admiral while Darla instead chose the crayfish; resulting in a significant otter effect (F = 8.77, P=0.010).

Other trends

When chasing prey, otters' average swim speed (0.94 ± 0.20 m/s) was significantly faster than their average cruising speed (0.49 ± 0.14 m/s) (n=16; F = 30.66, P<0.001). The otters also swam significantly faster when chasing brown trout (0.93 ± 0.15 m/s) compared to sunfish (0.86 ± 0.25 m/s) (n=8; F = 14.75, P<0.001). In 88% of the 38 prey captures otters consumed their prey on shore, and fish were always eaten tail first. The otters spent the least amount of time on land when handling and eating crayfish (40.9 ± 16.0% for crayfish; F = 9.84, P=0.002) but there was no significant difference between brown trout (63.3 ± 3.4%) and sunfish (72.2 ± 15.6%, F = 10.45, P=0.061).

Errors

In two brown trout and one sunfish size trials, the small prey hid in the small tube in the pool. The otters would check there when searching for prey but couldn't reach them, and the prey never came out before the trials ended. In the crayfish size trials, Admiral was unable to locate the small crayfish in two out of three trials. Darla caught all of the crayfish, but she only ate one of the small entirely; the rest were either chewed until dead and left on the bank, or only partially consumed, so only the search and chase times could be used for these small crayfish. Therefore, the sample size was reduced for these trials.

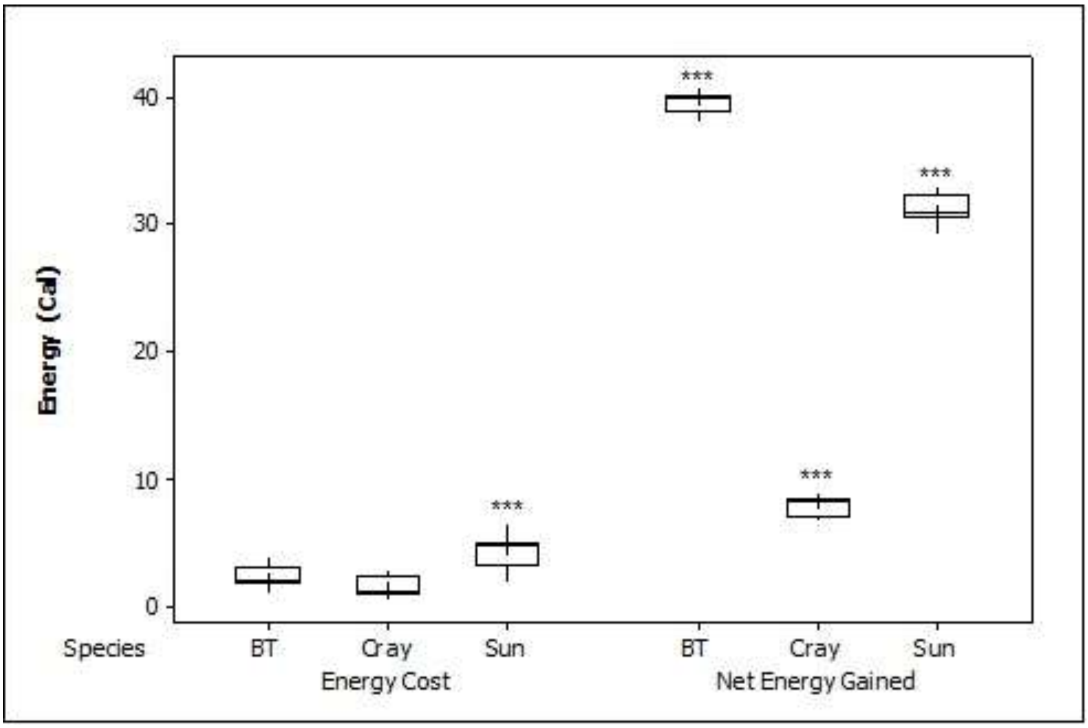

Figure 3a)

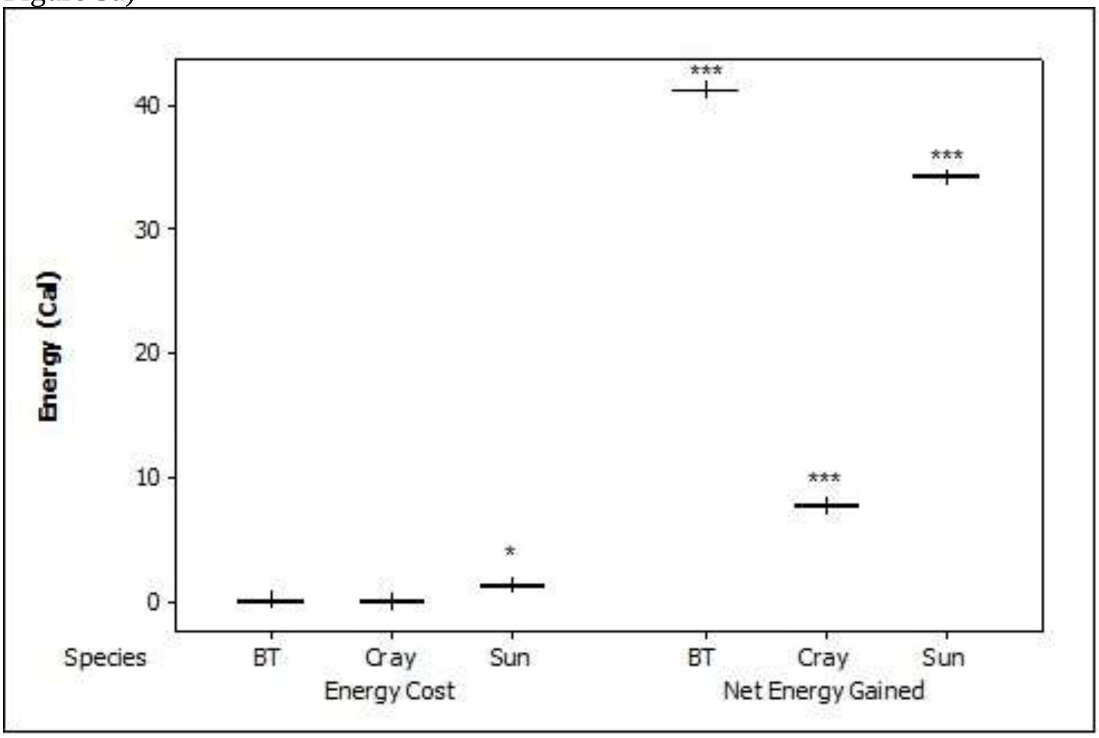

Figure 3b)

Figure 3. Energetics of species trials: energy cost calculated based on the otters' metabolic rates multiplied by time spent in water vs. time on land for each of the prey species; net energy gained calculated by subtracting the cost from the energy available in each prey type. A) live prey choices were offered to the otters in their pool, b) dead prey choices were offered to the otters in their holding pens. Asterisks denote statistical significance at $P \leq 0.05$*, $P \leq 0.01$**, $P \leq 0.001$***

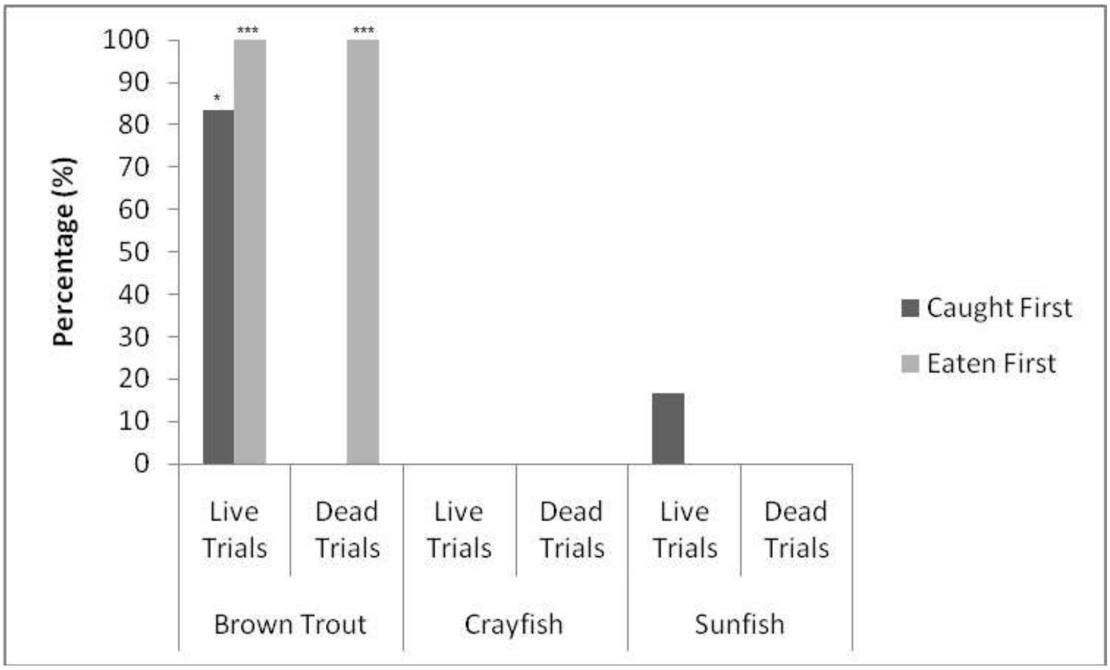

Figure 4. Otters preferences when offered three different prey species of similar size during species trials, based on the percentage of each that they caught or consumed first. Live prey choices were offered to the otters in their pool, N=6; dead prey choices were offered to the otters in their holding pens, N=12. Asterisks denote statistical significance at $P \leq 0.05$*, $P \leq 0.01$**, $P \leq 0.001$***.

DISCUSSION

Optimal foraging theory

The river otters displayed a clear preference for brown trout, which fits with the predictions from optimal foraging theory as trout provided significantly more Calories per unit time (R value). Otters also preferred large prey, catching and/or consuming large first for all three species, but this preference does not match our original prediction that energy rates would be maximized, as there was no significant difference in R values with size of crayfish or brown trout. We then decided to incorporate metabolic costs since the R value is calculated based only on total foraging time, but otter will expend more energy searching for and chasing prey in the water than when eating on land. For all prey species, the large individuals did provide significantly greater net energy gain compared to other prey sizes, which explains the otters' preference since the cost of searching, chasing, handling and eating the large prey was outweighed by their greater caloric value. Another benefit of catching larger prey is that otters can spend more time on the bank consuming the prey instead of diving repeatedly for multiple small prey items, which provides a thermoregulatory advantage (Kruuk, 2006).

Otters' preference for the brown trout also optimizes metabolic benefit since although the trout did not contain significantly more calories than the sunfish, they required lower energetic costs to capture and consume, thus providing the largest net energy gain. The result is that salmonids (e.g. brown trout) were preferred over centrarchids (e.g. sunfish); this contradicts the assertion that otters hunt inversely proportional to prey's swimming speed and ability to escape predation (Erlinge, 1968; Serfass et al., 1990; Cote et al., 2008; Stearns and Serfass, 2011). Brown trout were observed to move faster and have more agility than the other prey, so the otters did have to swim faster while foraging for brown trout compared to sunfish. Yet, otters spent more time chasing, handling, and consuming (H value) sunfish, which may be partially due to this species having a larger girth at the same length, but is more likely a result of their spiny dorsal fins which were an obvious impediment to handling.

The preferences we observed in this captive study may not occur in the wild, due to a range of habitats and available prey species. Sunfish inhabit shallow and muddy waters; this provides river otters with a predatory advantage (Tumilson and Karnes, 1987), so wild sunfish could be more beneficial than we considered here. Sunfish have been documented to be an important component of river otter diets in the wild (Serfass et al., 1990; Skyer, 2006; Barding and Lacki, 2012). Otters have been shown to consume salmonids (Greer, 1955; Melquist and Hornocker, 1983), but they may not be preyed upon when other warm water fish are available (Sheldon and Toll, 1964) due to their greater speed. Nonetheless, the importance of trout may be underestimated as many diet studies rely on scat analysis and trout may be difficult to distinguish because of its small scales (Hamilton, 1961). Crayfish are important seasonal prey in the wild as they are abundant in the summer months (Noordhuis, 2002; Skyer, 2006; Roberts et al., 2008) and many can be consumed in a relatively short period of time with little energetic cost to the otter. Although otters would need to consume more than four crayfish to equal the amount of energy gained from a single brown trout of the same length, Emlen (1966) predicted that an animal may eat a less rich or efficient prey choice if it is highly abundant.

Other studies have applied optimal foraging theory to explain prey preference in aquatic mammals. Bowen et al. (2002) studied foraging tactics of male harbor seals and found differences between cryptic prey. Seals ate sand lances (*Ammodytes dubius*) faster than flounder (Pleuronectids) although they required longer search time, and small to medium sand lances were more profitable than the same sized flounder. However, flounder were more profitable at larger sizes. These results were similar to our observations: otters invested less time eating crayfish compared to sunfish but sunfish were still more profitable than crayfish. Bowen et al. (2002) also found that profitability (kJ min^{-1}) increased with prey size for all consumed species. In our study, profitability did not increase with prey size until we accounted for the otters' metabolic requirements, but then there was a greater net energy gain with the large prey of all types. Ford and Ellis (2006) examined prey preference in fish-eating killer whales. Their primary prey was the Chinook salmon (*Oncorhynchus tshawytscha*) which is found year-round in the study area, although their numbers fluctuate. When other salmon were more abundant than the Chinook, the killer whales still preferred it because of its large size and high lipid content. Similarly, high energy content of the brown trout made it a preferred prey of otters in our study. In the Ford and Ellis (2006) study, rockfish (*Sebastes* spp) were also abundant but were thought to be avoided because of the dorsal spines, which is comparable to the otters' avoidance of sunfish when brown trout were available.

Observations

All prey types employed both active and passive defence strategies. The sunfish and crayfish were camouflaged against the sandy-coloured bottom of the pool and the small individuals of all prey types were able to hide in crevices. It was especially difficult for the otters to find the cryptic crayfish and a number entirely escaped detection. This supports Erlinge's (1968) observation that otters utilize sight to track prey, although they can also rely on their vibrissae to detect vibrations of their prey (Green, 1977). The crayfish also actively tried to protect themselves by pinching the otters instead of trying to escape by swimming, yet the otters were able to avoid this defence mechanism by grabbing the crayfish behind the claws. The otters could eat the smaller crayfish while swimming, but took the larger ones to the shallows and crushed them against the rocks. The fish also put up a struggle when caught, and they were eaten tail-first in every trial. Erlinge (1968) stated that the otters ate fish head-first in order to kill them faster. However, eating fish tail-first also has its advantages, as we observed that the otters would maim the fish during the handling time which reduced the ability of the fish to struggle and interfere with consumption. They nearly always ate their prey on land which disagrees with Kruuk et al. (1987) who found that most fish are eaten in the water and only large prey are taken to the shore. Since the otters landed most of the prey, it would be easier to hold the fish by the sturdier head than the flimsy tail. Also, if the heads were too large to swallow whole or too hard to eat through the bones, the otter would discard the head, which it wouldn't be able to do if it tried to eat its prey head-first.

In the dead trials, both otters always ate the brown trout, but they did not always eat the sunfish or crayfish. It's been documented that otters may not want to eat dead prey if they did not kill it themselves (Erlinge, 1968). Darla refused the thawed sunfish while Admiral avoided the thawed crayfish. Eating sunfish provides a significantly larger energy gain than crayfish, so from an optimal feeding standpoint, Darla's behavior does not match predictions. It could be that otters have a personal preference which may reflect differences in the taste of dead prey.

Potential limitations

As this was a captive study, caution must be exercised before extrapolating our results to the wild. In this study, the pool didn't offer prey the same protection available in a lake or a creek, which could alter measured search and chase times. The few hiding places in the pool did create a problem though as small fish sometimes swam into a tube where the otters couldn't catch them. About half the time, the fish swam back out, but when they remained in the tube until the trials were over, it reduced the sample size for small prey. Although this did not appear to effect the results since otters only selected small fish after larger ones, in the future this could be resolved by closing access to the tube with a mesh cover. In addition, all three prey types require different conditions in terms of water temperature and dissolved oxygen, and may not all be found in the same area at once in the wild so otters may not have the option of selecting between these choices. The significant difference between the lengths of the different prey species in the species trials (due to the smaller size of crayfish) should not have affected the conclusions as all prey types were similar in length, and energy comparisons factored the differences in weight into account. It is possible that the otters' prior experience with large trout from the size trials could have biased them to selecting prey that they knew could be larger. There is always the concern of individual variation since we only studied two otters, but they both exhibited the same preferences for both the size and live species trials with a significant otter effect only in the dead trials. Although the small sample size should be taken into account when extrapolating the results from this study to make general predictions, Cote et al. (2008) found that otters in a coastal marine environment selected less mobile and larger prey.

Conservation

Captive studies provide an opportunity to examine prey preferences in a controlled setting with the ability to observe underwater foraging behaviors impossible to view in the wild. Emlen (1966) originally predicted and more recent studies (e.g. Cote et al., 2008) have confirmed that animals should be more selective when food is not limited, thus the captive setting allowed us to observe what prey otters ideally prefer and is most energetically beneficial. Otters can consume 12% of their body weight in prey per day (Kruuk, 2006), so it is essential that suitable habitats with abundant and beneficial prey is conserved. Fish were shown to provide otters with a higher net energy gain, but crayfish are also important as they can be caught and eaten quickly when abundant. There should be little concern that otters will deplete game fish as the otters may not be able to catch them in the wild and other studies have concluded that otters do not destroy game fish (Knudsen and Hale, 1968; Serfass et al., 1990). Optimal foraging theory can be useful in predicting areas where wild otter populations may be successful due to foraging opportunities and identifying habitat suitable for reintroduction efforts.

Conclusions

As main conclusions we can state that:

1. River otters preferred the largest prey when provided with a choice of three different sizes of a single species.
2. When offered a variety of prey species, river otters preferred brown trout over similarly sized sunfish and crayfish, regardless of whether prey was alive or dead.
3. Preferences for size and species of prey matched predictions based on optimal foraging theory, as prey selection maximized net energy gained after accounting for the metabolic costs of foraging.
4. Controlled studies of captive animals can help predict optimal habitat for wild river otter populations.

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RÉSUMÉ

PRÉFÉRENCES ALIMENTAIRES DE LA LOUTRE DU CANADA ÉVALUÉES SELON LA THÉORIE DE L' « OPTIMAL FORAGING » (PRÉDATION OPTIMALE)

Les préférences alimentaires de la loutre du Canada (*Lontra canadensis*) ont été étudiées dans une population captive et évaluées selon la théorie de l' « optimal foraging ». Des perches-soleil (*Lepomis* spp.), des truites de rivière (*Salmo trutta*) et des écrevisses (*Cambaridae* spp.), ont été lâchées vivantes dans un bassin et les temps de recherche, de chasse et de consommations de ces proies par deux loutres ont été enregistrés. Quand elles ont le choix de la taille, les loutres montrent une nette préférence pour la capture et la consommation de grandes proies. Quand elles ont le choix de l'espèce, les loutres montrent une nette préférence pour les truites. Cette préférence demeure si la proie est morte. On pouvait s'attendre à une préférence pour la truite du fait du meilleur rendement énergétique apporté par unité de temps, mais le choix de la taille de la prise ne peut s'expliquer qu'en faisant intervenir le taux métabolique car les loutres dépensent plus d'énergie à chasser une proie dans l'eau qu'à la manger sur terre. Le bilan énergétique est plus favorable pour les grosses prises dans tous les essais sur la taille et pour la truite dans les essais sur les espèces de proies. Les loutres captives montrent des préférences prédictibles si on se fonde sur la théorie de l' « optimal foraging », ce qui donne des indices sur les habitudes alimentaires des populations de loutres sauvages.

RESUMEN

PREFERENCIA DE PRESAS DE LA NUTRIA NORTEAMERICANA (*Lontra canadensis*) EVALUADA EN BASE A LA TEORÍA DEL FORRAJEO ÓPTIMO

Se estudió la preferencia de presas de la nutria norteamericana (*Lontra canadensis*) en una población en cautiverio, y se la evaluó de acuerdo a la teoría del forrajeo óptimo. Se liberaron individuos vivos de perca-sol (*Lepomis* spp.), trucha marrón (*Salmo trutta*), y cangrejos de río (*Cambaridae* spp.) en una pileta, y se registraron los tiempos de búsqueda, persecución, y manipulación/ingesta, de dos nutrias. Cuando se les proporcionaban opciones de tamaños, las nutrias mostraron una preferencia significativa por capturar y comer primero las presas grandes. Cuando se les proporcionaban opciones de especies, las nutrias prefirieron significativamente capturar y comer primero a las truchas marrones; esta preferencia persistió cuando se ofrecieron presas muertas. Usando la tasa de ingesta de energía, era esperable la preferencia por la trucha marrón, al proporcionar significativamente más energía por unidad de tiempo, pero las preferencias de tamaño sólo encajan con las predicciones después de se incorporó la tasa metabólica, ya que una nutria gasta más energía para capturar la presa en el agua que para comerla en tierra. La energía neta ganada fue significativamente mayor para las presas grandes en todas los tests de tamaño y para la trucha marrón en los tests de especies. Las nutrias en cautiverio exhiben preferencias de presas que encajan con las predicciones basadas en la teoría del forrajeo óptimo, lo que puede ayudar a la comprensión de los hábitos dietarios de las poblaciones silvestres de nutrias.

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SHORT NOTE

OTTERS IN THE MONG LA WILDLIFE MARKET, WITH A FIRST RECORD OF HAIRY-NOSED OTTER *Lutra sumatrana* IN TRADE IN MYANMAR

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Abstract: Hunting and trade of otters in South-East Asia is a severe threat to the regional conservation of all four species. During surveys of the wildlife trade in the town of Mong La, Shan State, Myanmar, three species of otters were observed, including a skin of a Hairy-nosed Otter *Lutra sumatrana*. This is the first record of this species in trade in Myanmar, and the second record of the species in the country.

Keywords: *Lutra*; otter; poaching; wildlife trade

Four species of otters have been recorded from Myanmar, including Small-clawed Otter *Aonyx cinereus*, Smooth Otter *Lutrogale perspicillata*, Eurasian Otter *Lutra lutra* and Hairy-nosed Otter *L. sumatrana* - the latter recorded for Myanmar from a single museum specimen only (Duckworth and Hills, 2008) and unconfirmed occurrence in the Irrawaddy delta, as illustrated in the map on *The IUCN Red List of Threatened Species* page (Hussain et al., 2008). Three of these species are considered globally threatened in *The IUCN Red List of Threatened Species* (2013): Small-clawed Otter and Smooth Otter are assessed as Vulnerable, Hairy-nosed Otter as Endangered. Eurasian Otter is assessed as Near Threatened.

Otter populations are under rapid decline across most of mainland South-East Asia, largely due to habitat loss and habitat conversion, and due to hunting for trade, to the point where regional extinctions of one or more species is a real possibility (Duckworth and Hills, 2008). In a national-level analysis of small carnivores in Myanmar, otters were considered to be the most severely threatened species (Than Zaw et al., 2008). Of the four species of otter native to Myanmar, only the Hairy-nosed Otter is not protected under the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994, because it was not recognised as occurring in Myanmar (Than Zaw et al., 2008).

On 1-2 January 2014, we visited the town of Mong La, Myanmar, to carry out wildlife trade surveys. Mong La is situated in a Special Development Zone in the Shan State adjacent to Yunnan Province, China, and is known to be a significant wildlife trade hub (Shepherd and Nijman, 2007). An inventory of wildlife was carried out in the market (wet market selling fresh produce, fish and freshly hunted animals), wild meat restaurants and retail outlets there on 1 January and of freshly delivered carcasses and live animals in the market again on 2 January, because deliveries of freshly killed animals from hunters are daily (Shepherd and Nijman, in prep.).

Otter parts and carcasses were observed for sale in the market and in one retail outlet, but not in the wild meat restaurants during this survey. In one retail outlet, specialising in wildlife parts mostly for luxury and trophies, an unidentified otter skin was observed for sale. In the market, one complete otter skeleton, two fresh Small-clawed Otter carcasses (Figure 1) and four skins were observed. While three of the skins were not identifiable, the fourth, recognised immediately by the hair-covered rhinarium (short brown fur, slightly lighter in colour than the fur covering the body) was a Hairy-nosed Otter (Figure 2). It was compared with a Small-clawed Otter skin in the pile beside it which further showed the noticeable difference on the nose.

Figure 1. A freshly killed Small-clawed Otter for sale in the Mong La market, where animals are brought in daily by local hunters, 1 January, 2014.

To date, there is only one known record of Hairy-nosed Otter from Myanmar, a specimen collected at Gam Majaw, in Kachin state, northern Myanmar, on 6 April 1939 by Ronald Kaulback, which is currently held in the Natural History Museum, London (Duckworth and Hills, 2008).

While there are some parts of wildlife not native to South-East Asia for sale in the higher-end retail shops in Mong La, such as Tibetan Antelope *Pantholops hodgsonii* horns, no species not native to Myanmar were observed in the market, which consisted of animals brought in daily by local hunters from the Myanmar side of the border. However, it is not impossible that the Hairy-nosed Otter observed in this market originated elsewhere, though it seems highly unlikely, given that it was in a stack of other otter skins in the market, as opposed to being in a novelty trophy shop.

Poaching is considered to be a threat throughout the range of the Hairy-nosed Otter (Hussain et al., 2008), but this observation constitutes the first record of Hairy-nosed Otter in trade in Myanmar. This apparent contradiction may reflect both the paucity of market surveys in Myanmar and the country’s location at the edge of the species’s range or possibly that otter remains are transported directly to known buyers rather than placed for open sale in markets or some other factor. Concerted efforts to monitor the trade in otters, and to work with the authorities in Myanmar to reduce poaching and trade in otters, are essential. It is also essential that the Government of Myanmar provide full legal protection for the Hairy-nosed Otter, so that future enforcement efforts may benefit this threatened otter.

Figure 2. A close-up of the rhinarium of the Hairy-nosed Otter observed in the Mong La market, 1 January, 2014.

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RÉSUMÉ
DES LOUTRES EN VENTE AU MARCHÉ DE MONG LA AVEC UNE PREMIÈRE DONNÉE D'UNE LOUTRE DE SUMATRA (*Lutra sumatrana*) EN VENTE AU MYANMAR
La chasse et le commerce des loutres en l'Asie du Sud Est représentent une menace sévère pour la conservation locale des quatre espèces de loutres. Lors d'enquêtes sur le commerce des animaux sauvages dans la ville de Mong la, Etat de Shane, Myanmar, trois espèces de loutres ont été observées, dont une peau de loutre de Sumatra (*Lutra sumatrana*). C'est la première donnée pour le commerce de cette espèce au Myanmar et la seconde pour le pays.

RESUMEN
NUTRIAS EN EL MERCADO DE FAUNA SILVESTRE MONG LA, CON UN PRIMER REGISTRO DE LA NUTRIA DE SUMATRA Lutra sumatrana SIENDO COMERCIALIZADA EN MYANMAR
La caza y el comercio de nutrias en el Sudeste de Asia es una severa amenaza a la conservación regional de las cuatro especies existentes. Durante relevamientos del comercio de fauna silvestre en la ciudad de Mong La, Estade Shane, Myanmar, fueron observadas tres especies de nutrias, incluyendo un cuero de una nutria de Sumatra, *Lutra sumatrana*. Este es el primer registro de esta especie en el comercio en Myanmar, y el segundo registro de esta especie en el país.

SHORT NOTE

REPRODUCTION OF REINTRODUCED NORTH AMERICAN RIVER OTTER (*LONTRA CANADENSIS*) CONFIRMED IN NEW MEXICO

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Abstract: The North American river otter (*Lontra canadensis*) was considered to have been extirpated from New Mexico during the second half of the twentieth century. From 2008-2010, the species was reintroduced to the state; since then, there has been no formal study to evaluate the success of the new population. We conducted informal surveys in 2012-2013 in northern New Mexico in an attempt to ascertain basic demographics of the reintroduced population. We observed four otters, an adult and three juveniles, on two occasions during the summer of 2013 on the Rio Grande in Orilla Verde Recreation Area (Taos County). We photographed the adult and one juvenile on one of these occasions. This represents the first confirmed evidence of river otter reproduction since their reintroduction to the state. Additional research will be required to clarify range extents, dietary habits, ecosystem impacts, and other information important to local wildlife managers.

Keywords: observation, reintroduction, *Lontra canadensis*, juvenile, BEMP

INTRODUCTION

The North American river otter (*Lontra canadensis*) was historically native to New Mexico's riverine ecosystems (Bailey, 1931; Findley et al., 1975). It is thought that overhunting and habitat destruction drove the decline of the river otter in New Mexico (Savage and Klingel, 2008). The last known native otter was killed in a beaver trap in 1953 (McClellan, 1954). A few unverified reports of otter in New Mexico between 1953 and 2005 exist mainly from around the area of the Colorado border (NMGDF, 2006). In 2005, Polechla asserted the presence of otter in New Mexico based on genetic analysis of scat samples collected on the San Luis River in the area of Navajo Lake. Due to the general paucity of evidence of otters, the species was considered by managers to be extirpated from the state, or existing in populations too small to be self-sustaining (Findley et al., 1975), though the limited area of the reports indicated possible migration of otters from Colorado (NMGDF, 2006).

In October 2008, five river otters were released by a partnership of federal, state, nonprofit, and tribal agencies into the Rio Pueblo de Taos, a tributary to the Rio

Grande. In total, thirty-three otters were released at this site from 2008-2010. There has been no formal demographic study conducted since the release period to assess the reintroduced population. However, some reports compiled by the New Mexico Department of Game and Fish (NMDGF) between 2009 and 2012 were suggestive of successful river otter reproduction in New Mexico:

- A female otter collected as roadkill near the Rio Grande south of Pilar (Taos County) in July 2009 appeared to be post-lactating based on the condition of the teats.
- In December 2009, four otters were observed and photographed on the San Juan River in northwestern New Mexico (where the species may be establishing via dispersal from Colorado or Utah) and one was reportedly larger in body size than the others.
- In June 2012, five otters, including one that appeared to be larger than the others, were observed in the Taos Gorge of the Rio Grande
- Two observations of up to six otters together in the lower Rio Chama (another tributary to the Rio Grande) in August 2012 represent another possible family group.

[All reports J. Stuart, NMDGF, pers. comm., 2013]

Taken together, these reports seem to positively indicate otter reproduction in New Mexico. However, until this point in time no photographs clearly confirmed whether or not some of these observed otters may have been juveniles.

In June 2012, the Bosque Ecosystem Monitoring Program (BEMP) began a series of informal summer surveys in order to ascertain basic demographics of the river otter population in northern New Mexico. We surveyed on foot on the bank or on the river in a two-person inflatable kayak. The study area included the Rio Grande from Taos Junction Bridge in the Orilla Verde Recreation Area (Taos County) to the town of Embudo (Rio Arriba County); portions of the Rio Embudo near its confluence with the Rio Grande; and, with permission of the War Chief of Taos Pueblo, the Rio Pueblo de Taos near the original river otter release site (Fig. 1). In the course of this study, an adult otter and three juveniles were observed in two instances during floating surveys within Orilla Verde Recreation Area. We have assumed that the same family group was observed on both instances.

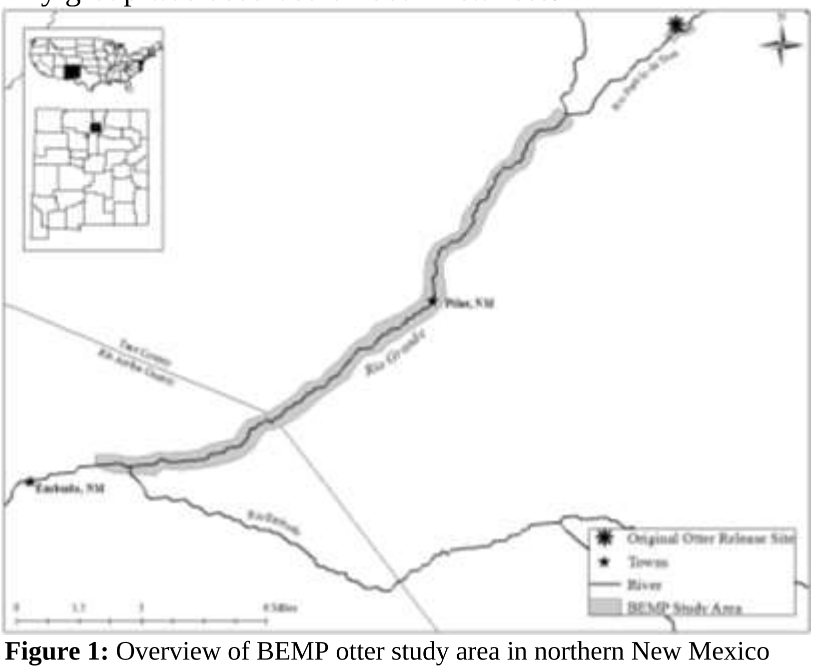

Figure 1: Overview of BEMP otter study area in northern New Mexico

The otters were first observed during a floating survey on June 15, 2013 in the middle of the Orilla Verde Recreation Area, just above the United States Geologic

Survey streamflow gauge in the park (N 36^o 19.239', W 105^0 45.244', +/- 5m). The adult and pups were standing on the rocks of the riverbank, which adjoined the sheer cliff face of the canyon. As we passed by the bank with our kayak, the adult grunted at the pups, who were about half its size and darker in coloration, and the pups hid behind the rocks. The adult remained for some time watching us warily as we observed it, flattening itself against the rocks. We returned to the site two hours later, after the conclusion of the floating survey, in order to photograph the site of the observation for future reference. The otters were still hiding in the rocks, and we managed to photograph the adult and one of the pups from the opposite bank when they poked their heads out of the rocks (Fig. 2, 3). We continued to monitor this site in June and July with floating surveys, observations on foot from the opposite bank, and camera traps, but no further activity was observed at the site. However, we did find and collect fresh scat from a latrine near the site one week after the initial sighting. Due to the limited activity observed at the site after the first instance, as well as the assumed age of the pups based on the time of year, it seems likely that this was a temporary shelter rather than a natal den site.

We observed an adult and two young on one more occasion on June 22, 2013, just below Taos Junction Bridge (N 36 20.082', W 105 44.135', +/- ?m). Though there was one fewer juvenile present than in the group observed the week before, we presume that it was the same family group due to the relatively short distance from the

Figure 2: Adult otter in Orilla Verde Recreation Area, June 2013. Note the darker-colored pup hidden slightly in the rocks to the left. Photo credit: Aaron Gjullin, Bosque Ecosystem Monitoring Program, 2013

Figure 3: Juvenile otter in Orilla Verde Recreation Area, June 2013. Note the lighter-colored adult otter hidden slightly in the rocks to the right. Photo credit: Aaron Gjullin, Bosque Ecosystem Monitoring Program, 2013

site of the first observation. The otters were again standing on rocks adjoining a sheer bank below a small set of rapids. We had not yet set up our camera due to the rapids. The adult startled upon sighting us, and grunted at the pups. The otters dove into the water and fled the area before we could manage to photograph them. The area was monitored carefully on future surveys, but since the site was located directly across the river from a popular campground, we considered it unlikely that this was a regular shelter site for otters given their flight response in the presence of humans.

These observations and photographs provide the first confirmation of river otters breeding in New Mexico since their reintroduction to the state. Although a reproducing population of river otter presumably occurred historically in the Rio Grande and other New Mexico rivers, no verified evidence of such a population was known to exist during the second half of the 20th century (J. Stuart, NMDGF, pers. comm. 2013). Reproduction may imply some success to the river otter reintroduction program in northern New Mexico. However, the extent of recolonization by river otters in northern New Mexico is far from clear. Over the course of two summers of study of this population, these were the only two incidents in which we observed live animals. Further research will be required to establish the extent of their range in the state, population estimates, dietary habits, impacts of reintroduction on the local ecosystem, and other important data for local wildlife managers.

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RÉSUMÉ

CONFIRMATION DE LA REPRODUCTION DES LOUTRES DU CANADA (*Lontra canadensis*) RÉINTRODUITES DANS L'ÉTAT DU NOUVEAU MEXIQUE

La loutre du Canada (*Lontra canadensis*) était supposée éteinte de l'état du Nouveau Mexique depuis la deuxième partie du vingtième siècle. Entre 2008 et 2010, l'espèce a été réintroduite dans cet état; depuis aucune étude n'a été conduite pour quantifier l'établissement de cette nouvelle population. Nous avons mené plusieurs études informelles en 2012-2013 dans le nord du Nouveau Mexique dans le but d'établir les bases de la démographie de cette population réintroduite. Nous avons observé quatre loutres, un adulte et trois jeunes, en deux occasions pendant l'été 2013 sur le Rio Grande dans la zone de récréation d'Orilla Verde (Taos Country). Nous avons photographié l'adulte et un juvénile lors d'une de ces occasions. Cela représente la première preuve de reproduction de cette population réintroduite. Des recherches supplémentaires seront nécessaires pour établir l'aire de répartition, le régime alimentaire, les impacts sur l'écosystème, et d'autres informations importantes pour les décideurs environnementaux.

RESUMEN

CONFIRMACIÓN DE LA REPRODUCCIÓN EN NUEVO MEXICO DE LA NUTRIA DE RÍO NORTEAMERICANA (*Lontra canadensis*) REINTRODUCIDA

Se consideraba que la nutria de río Norteamericana (*Lontra canadensis*) había sido extirpada de Nuevo Mexico durante la segunda mitad del siglo veinte. En 2008-2010 la especie fue re-introducida en este estado; desde entonces, no se realizó ningún estudio formal para evaluar el éxito de la nueva población. Realizamos prospecciones informales en el norte de Nuevo Mexico durante 2012-2013, en un intento por comprobar la demografía básica de la población re-introducida. Observamos cuatro nutrias, un adulto y tres juveniles, en dos ocasiones durante el verano de 2013 en el Río Grande, en el Area Recreativa Orilla Verde (Condado de Taos). Fotografiamos al adulto y a un juvenil en una de estas ocasiones. Esto representa la primera evidencia confirmada de reproducción de las nutrias desde su re-introducción en el estado. Será necesaria investigación adicional para clarificar la extensión del área de acción, hábitos alimentarios, impactos en el ecosistema, y otra información importante para los administradores locales de fauna.

SHORT NOTE

A REVIEW OF HISTORICAL HABITAT AND THREATS OF SMALL-CLAWED OTTER ON JAVA

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Abstract: A review of some new sources of historic information confirm that the Oriental Small-clawed Otter *Aonyx cinerea* uses a range of non-forest habitats on the Indonesian island of Java. Persecution for its habits to feed in fish ponds is a major threat to this species, and this should be considered when developing conservation strategies for reversing its declines.

INTRODUCTION

Meijaard (2010a,b) reported on several records of Oriental Small-clawed Otter *Aonyx cinerea* in an urban environment on Java, Indonesia. This includes his own sightings of these otters in a housing complex in southern Jakarta, where the species used the local drainage system for feeding, and where animals were frequently seen at night crossing roads from one drain to another (Meijaard, 2010b). Subsequent to this publication, another Jakarta resident observed relatively large numbers of otters (groups of up to 16 animals) for some time near his home in south Jakarta, not far from the area where Meijaard had initially sighted the animals (Meijaard, 2010a). These observations raise the question as what constitutes the range habitats typical of the species on Java, and to what extent is it affected by habitat loss or by other factors, such as hunting. In Jakarta, West Java, the species apparently depends on a diet of invertebrates (mostly crustaceans) which it obtains in a series of interconnected drains and small canals and in a larger river without much riverine vegetation. This is not unlike the species' natural habitat in West Java as described on the IUCN Red List (Bartels, 1937; Hussain and de Silva, 2008), which includes wetland systems having pools and stagnant water, including shallow stretches, with depth less than 1 m, in freshwater swamps, meandering rivers, mangroves and tidal pools. No specific mention is, however, made about the species' occurrence in urban environments, although elsewhere the species is indicated to occur in a range of anthropomorphic habitats, including rice fields, fishponds, crab-ponds, fishery areas along the coast, in creeks along tea plantations, in irrigation channels related to the aforementioned habitats, as well as in the middle of a town (Melisch et al., 1996). If the species survives in open areas, such as rice fields to what extent is it then threatened by the loss of forested swamps and mangroves, as suggested in the IUCN Red List (Hussain and de Silva 2008)? This is an important consideration, because understanding what constitutes the main threat to a species is crucial in developing effective conservation strategies. Here I add to the discussion by reviewing the Netherlands-Indies' historical literature on *A. cinerea* in Java to see how commonly the species occurred in non-forest environments at a time when forest cover on Java was much more extensive (Whitten et al., 1996), and what other threats were reported. Because most of these articles were written in Dutch they have remained outside the published scientific literature on Indonesian otters.

Aonyx cinerea in Halimun NP, Java - photo Age Kridalaksana

Findings from the historical literature

Between 1815 and 1927, *Aonyx cinerea* was collected from a range of urban and rural localities, including Batavia [= Jakarta], Batutulis (near Bogor), and Buitenzorg [= Bogor] (van Strien, 2001), although from these locality names only it cannot be worked out in which environments they were collected. Other historical evidence, however, indicates that the species made extensive use of agricultural and urban habitats. Van Blommestein (1886) mentions that in Batavia (now Jakarta), the 'otter' caused major losses in the city's many fish ponds. Attempts to eradicate the otter had remained ineffective, mostly because it was very difficult to hunt because of its elusive behavior. It is unclear though whether the author refers to *A. cinerea*, to Smooth-coated Otter *Lutrogale perspicillata*, or to a mix of both; *L. perspicillata* is the only other otter known from Java (Hussain et al., 2008), although generally it is found in the much bigger rivers (Bartels, 1934). Specifically about *A. cinerea*, Bartels (1934) writes that the species appears to move rapidly between habitat patches, using certain areas with fish ponds or small rivers for several days and then moving on to other areas. This was also noted in South Malang, East Java, where the species would be absent from certain rice field areas, but then reappear in large numbers. In such habitats, *A. cinerea* primarily fed on crabs and fish and did not hesitate to come close to built-up areas if fish could be obtained (Bartels, 1934). In the 1920s, *A. cinerea* was still thought to be common around the town of Buitenzorg (= Bogor), where the species could be observed at night with relative ease on the banks of rivers that flow through this town (Leefmans, 1920). The species commonly nested in disused buildings, hollow trees on the river bank, or holes in these river banks, and the species' young were often flushed out and caught when the river banks flooded (Leefmans, 1920).

Eradication of otters was considered to be difficult. Fish pond owners primarily used sharpened bamboo sticks inserted in the bottom of the ponds, not so much to kill otters, but rather to provide fish with places to hide (Bartels, 1934). Shooting them was thought to be very difficult (Bartels, 1934). In Malang (East Java), where the species is no longer known to occur (Melisch et al., 1996), other methods were used to control otters. The cultivation of carps in ponds was badly affected by otters and birds of prey, and the Freshwater Fish Department had developed effective traps that managed to reduce otter population significantly (Anonymous, 1938 a,b). Elsewhere on Java such trapping methods were also considered effective for controlling otters (Anonymous 1925).

DISCUSSION

The historical information presented here, as well as in the literature review by Melisch et al. (1996), indicates that in the 19th and early 20th century, *Aonyx cinerea* was relatively commonly encountered in agricultural and urban or semi-urban environments on the island of Java. The species was considered a pest to commercial fisheries and both governmental authorizes and local people did their best to eradicate it. This might explain why the species still occurs in seemingly unsuitable environments, such as the heavily polluted waterways of Jakarta, an urban conglomeration with some 20 million people and some of the highest human population densities in the world. If indeed human persecution, rather than habitat loss is among the more important threats to *A. cinerea*, a city like Jakarta where few people hunt or depend on fishing or fish keeping for their livelihoods might provide one of the few relatively save refuges for the species. This seems counterintuitive, but it is important to realize how intensively hunted and collected wildlife in Java's forest and agricultural landscapes is. Once very common species that occurred in all natural and human-made environments, such as the Common Gecko *Gekko gecko*, have been collected to near extinction throughout the island because of local demand or demand from the Asian mainland for medicinal use (Meijaard and Achdiawan, 2011). Such high killing and trapping rates would likely also affect *A. cinerea*, especially because it is not protected in Indonesia (Noerdjito and Maryanto 2007).

I recommend renewed efforts that focus on describing remaining populations of *A. cinerea* on Java and how these are most threatened. A review of all reported records of the species in field survey reports and university theses would be a first useful step. On the basis of resulting presence records, well-designed interview surveys (Mohd-Azlan et al., in press) might be the most useful techniques to rapidly obtain information about current population status and threat on the island, and recent trends in numbers. I call on the Otter Specialist Group to help facilitate such surveys.

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RÉSUMÉ : Un Examen de l'Habitat Historique et Menaces à Loutres Cendrées sur Java

Une revue de nouvelles sources de données historiques confirme le fait que la loutre naine cendrée *(Aonyx cinerea*) utilise certains habitats non forestiers de l'île Indonésienne de Java. La destruction de cette espèce est liée à sa prédation sur les poissons d'étang et représente la menace principale. Les stratégies de conservation de cette espèce pour enrayer son déclin doivent prendre en compte cet aspect.

RESUMEN: REVISIÓN DEL HÁBITAT HISTÓRICO Y LAS AMENAZAS DE LA NUTRIA ASIÁTICA DE UÑAS PEQUEÑAS, EN JAVA

La revisión de algunas nuevas fuentes de información histórica confirma que la nutria asiática de uñas pequeñas *Aonyx cinerea* utiliza un espectro de hábitats no-forestados en la isla Indonesia de Java. La persecución debido a su hábito de alimentarse en pisciculturas es una gran amenaza para esta especie, y ésto debería ser tenido en cuenta al desarrollar estrategias de conservación para revertir su declinación.

KESIMPULAN: TINJAUAN SEJARAH HABITAT DAN ANCAMAN BAGI SERO AMBRANG DI PULAU JAVA

Tinjauan atas beberapa sumber baru dari informasi historis menunjukkan bahwa Sero Ambrang *Aonyx cinerea* (berang-berang) hidup di berbagai habitat di luar hutan di pulau Jawa, Indonesia. Pencegahan terhadap kebiasaan Sero Ambrang untuk makan di kolam ikan (empang) adalah ancaman utama terhadap species ini, dan hal ini harus dipertimbangkan ketika menyusun strategi konservasi untuk mencegahnya dari kepunahan.

SHORT NOTE

TEMPORAL DETECTION PATTERNS OF THE AFRICAN CLAWLESS OTTER *Aonyx capensis* (SCHINZ, 1821) IN THE LAIKIPIA PLATEAU OF CENTRAL KENYA

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Abstract: The detection time of the African clawless Otter along its habitat was studied from January 2013- April 2013 over 720 trap nights. Camera traps were set up in six sites of different altitudes along the riparian area of the Ewaso Nyiro River in Central Kenya. Based on the still pictures and the time recorded in the snapshot: 50.68% of their occurrence was found to be between 18h00 and 00h00 in the evening, 41.78% between 00h00 and 06h00 in the morning and an insignificant 7.53% between 06h00 and 18h00 during the day. This evidence suggests a temporal detection niche for the African clawless Otter in this ecosystem, which is empirical verification in line with its known cryptic and nocturnal behavior.
Keywords*:* Laikipia, *Aonyx capensis*, detection, temporal, niche, and camera traps

INTRODUCTION

The African clawless otter is listed as a species of least concern by the International Union for the Conservation of Nature (Hoffmann, 2008). However, relatively few ecological studies have been conducted on the species outside of southern Africa. Comprehensive assessments of the feeding habitats and distribution of the African clawless otter have been conducted in southern Africa environments (Nel and Somers, 2007; Parker et al., 2007; Somers and Nel, 2005; Watson and Lang, 2003). The ecology of the African clawless otter is for the most part not well studied in East Africa. In fact, only two studies for the species have been conducted in the region, both focusing on feeding habits in freshwater habitats (Kruuk and Goudswaard, 1990; Ogada, 2007).

Studies of the activity patterns of African clawless otter have been conducted through radio-telemetry (Somers and Nel, 2005). However, activity pattern of the species has not been widely monitored in Africa through the use of remote-sensing cameras. Use of remote-cameras has provided useful information of riparian visitation patterns for other otter species at latrines e.g. the Eurasian Otter (*Lutra lutra*)

(MacDonald and Harrington, 2012). Our study therefore, is designed to provide insight into the detection patterns of the African clawless in riparian areas along riverine habitats in north central Kenya through the use of similar remote-sensing cameras.

STUDY AREA

Our study was conducted in the Laikipia county of North-central Kenya in over 100Km of the Ewaso Nyiro River. The Laikipia plateau is located east of the Great Rift Valley between latitudes 0°17′S–0°45′N and longitudes 36°10′E–37°3′E hemmed in the west by the Aberdares range, to the south and south-east by Mt. Kenya, and to the east by the Mukogodo hills. It averages 2000 m in altitude and rises to over 2500 m on the Aberdares slopes and 2250 m on the slopes of Mt. Kenya. With an area of about 9723 km^2, most of Laikipia is low country with numerous broad and generally grassy volcanic ridges cut into by two major rivers, the Ewaso Narok and Ewaso Nyiro, with various tributaries flowing down from the Aberdares and Mt. Kenya. (Wambuguh, 2007). The specific study sites were along the Ewaso Nyiro River at the Timau-Nanyuki rivers junction at Jua kali **(D)**, Nanyuki-Ewaso nyiro junction to the north of Mpala **(C)**, Ewaso Nyiro-Ewaso-Narok junction at Lamarti camp **(A)**, Sosian bridge on the Ewaso Narok river **(B)**, William Holden Bridge on the Northern Ondare river **(F)** and Kibubungi on the Upper Ewaso Nyiro on the South West corner of Ol pejeta **(E)** (Fig 1).

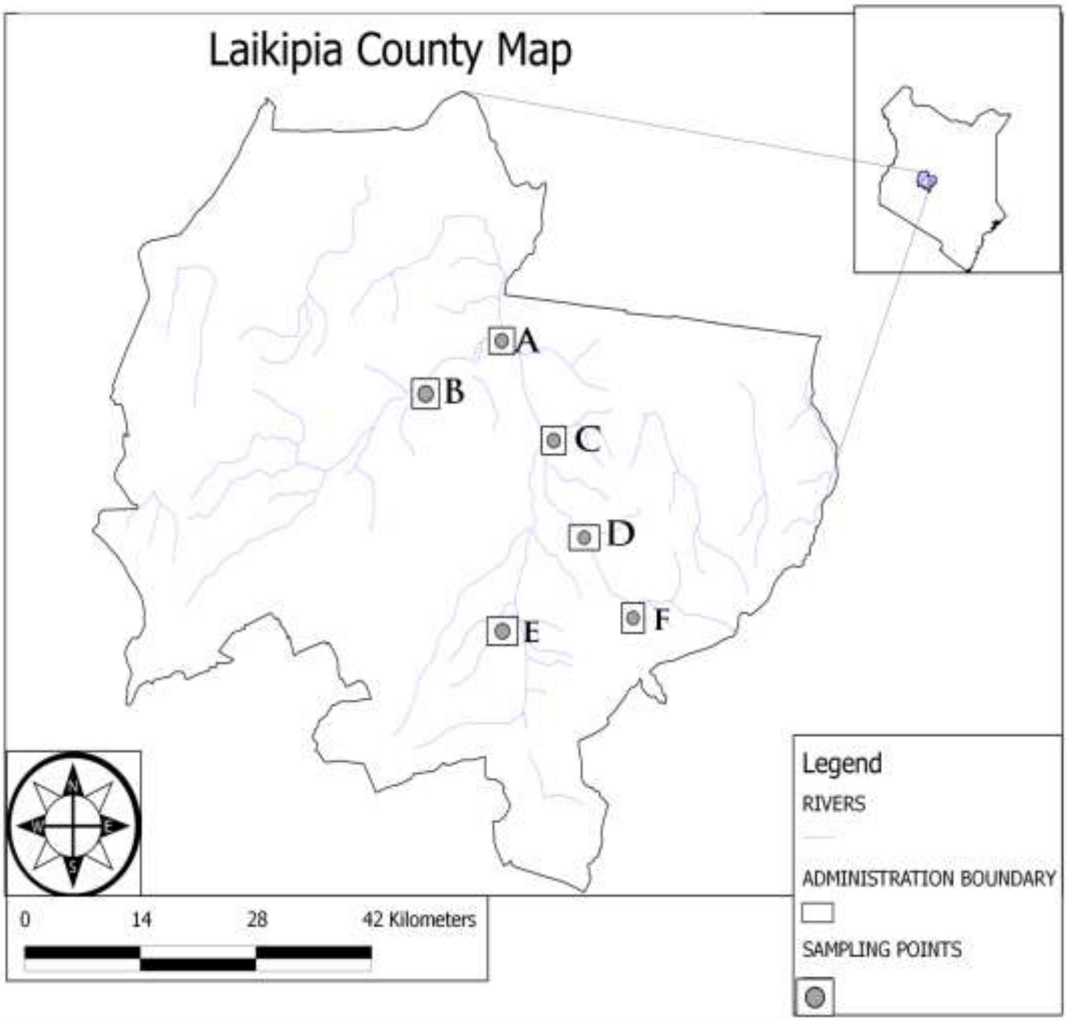

Figure 1. Study area

METHODS

Twenty one potential sampling points at the Ewaso Nyiro river system were identified from previous preliminary otter latrine surveys. Six sites were randomly selected from the 21 latrine sites and monitored for 720 camera trap nights between January and April 2013. Camera traps (Moultrie Game Spy M-80 series ®) were placed in the selected otter latrines at 0.5-metres above the ground and fastened onto firm structures such as tree stems and stumps around the otter latrine area. They were concealed as much as possible to avoid theft whilst leaving enough room for the lens to clearly capture the animals clearly. Scent lures were also applied on twigs around the camera and placed within the camera range i.e. < 5 meters on the trail. The data from the cameras were downloaded from their respective memory cards fortnightly, as well as re-baited with new scent lures and checked if the memory stick and batteries were still functional. The settings used were such that there was a delay of 5 minutes between each exposure to increase chances of unique detections as opposed to the same individual. The trap was also set in such a way that the date and time of each shot was recorded at the base of each picture. The cameras were left to survey day and night over the study period. Information from each camera was then analyzed to look for temporal detection patterns. The interest of the study was not identification of unique animals but temporal detection patterns and hence detection from the same individual was considered unique as long as it was in different time quarters i.e. 00h00 – 06h00,06h00-1200h,1200 - 18h00,18h00 – 00h00.

Results and Discussion

Cameras were functional for 87.8% of the time due to technical (Memory card and battery) issues and hence there was a a net camera Trap Night (TN) of 632 TN out of the initially envisioned 720 TN. Overall trap success for all cameras combined was therefore 23.1 captures per 100 (TN). Camera location **E** had the highest trap success at (10.3/100 TN), followed by: **A** (9.01/100 TN); **C** (3.48/100 TN) and **F** (0.32/100 TN). Camera locations **B** & **D** did not have any detections.

In total one hundred and forty-six detections were recorded (Table 1), 65 in camera location **E**, 57 in camera location **A**, 22 in camera location **C** and 2 in camera location **F**. Two camera locations **B** & **D** did not have any detections. Detections were recorded for 23 days at camera **E**, 18 days at camera **A**, 7 days at camera **C** and 1 Day at camera **F;** overall detections recorded was 49 days at all the cameras, with no detections in **B** & **D**.

Most detections occurred during the night in the study period, with 92.46% i.e. 41.78% between 00h00 – 06h00 and 51.68% between 18h00 – 00h00 representing occurrences at night. Only 7.53% occurred between 06h00 –18h00 i.e. during the day, and when they did occur, they did so either very early in the morning at dusk or very late in the evening at dawn.

Table 1. Percentage frequencies of occurrences of the African clawless Otter over a temporal scale in the Laikipia ecosystem, between January 2013 – April 2013

Day/Night	Time frames	Frequency of occurrence(n)	% Occurrence
Night	00h00–06h00	61	**41.78***
Day	06h00–12h00	8	5.48
Day	12h00–18h00	3	2.05
Night	18h00–00h00	74	**50.68***

Laikipia virtually being on the equator at a latitude of 0°17′S–0°45′N and an average Sunrise of 06h35 and Sunset at 18h43 , provides an almost ideal 12–hour day and night experimental window for a temporal study.

It was interestingly observed that the African clawless Otter intentionally avoided expressly using its territory during the day. A further insightful look into the study sites reveals that sites near small agricultural farms growing subsistence maize and potatoes produced more occurrences on the trail. This coupled with complaints by the farmers on destruction of their young plant shoots; might suggest that the African clawless Otter is a probable vermin for these small scale farmers.

In principle, as humans continue to expand their distribution into habitats that have historically contained carnivores, there will be a more pressing need for temporal datasets examining both behavioral and ecological parameters of carnivores for sustained co-existence. (Beckmann and Berger, 2003).The relatively new remote camera traps methods provides such an opportunity for studying of these temporal niches for such cryptic species as the African clawless Otter.

CONCLUSION

Our data offer an empirical evidence of the nocturnal detection pattern of the African clawless Otter by showing how it has managed to carve out its own crepuscular foraging niche in the Laikipia ecosystem. This conclusions would however be complemented if observation of these nocturnal detection pattern can be carried out in different geographical areas to determine if this behavior is universal for this species.

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RÉSUMÉ

PROFIL TEMPOREL DE DÉTECTION DE LA LOUTRE AFRICAINE À JOUES BLANCHES, *Aonyx capensis* (SCHINZ, 1821), SUR LE PLATEAU LAIKIPIA DU KENYA CENTRAL

La période de détection de la Loutre Africaine à joues blanches le long de son habitat a été menée de Janvier 2013 à Avril 2013 avec l'utilisation de 720 cameras nocturnes. Ces caméras ont été placées sur 6 sites à différentes altitudes le long de la zone riparienne de la rivière Ewaso Nyiro au Kenya central. Basé sur les photos obtenues et l'heure indiquée sur le cliché, 50,68% de leurs apparitions se situent le soir entre 18h00 et minuit, 40,78% le matin entre minuit et 06h00 et de façon non significative 7,53% entre 6H00 et 18H00 la journée. Cette preuve suggère un créneau temporel de détection de cette Loutre Africaine à joues blanches dans son écosystème, qui constitue une vérification empirique en accord avec son comportement cryptique et nocturne connu.

RESUMEN

PATRONES TEMPORALES DE DETECCIÓN DE LA NUTRIA DE MEJILLAS BLANCAS *Aonyx capensis* (SCHINZ, 1821) EN LA MESETA DE LAIKIPIA, KENIA CENTRAL

Estudiamos los períodos de detección de la nutria de mejillas blancas africana, a lo largo de su hábitat, desde Enero de 2013 a Abril de 2013, en base a 720 noches-cámara. Dispusimos cámaras-trampa en seis sitios a diferentes altitudes a lo largo del área ribereña del Río Ewaso Nyiro en Kenia Central. Basados en las fotos obtenidas y la hora registrada en la misma: 50.68% de las ocurrencias fueron entre 18h00 y 00h00 por las tardes-noches, 41.78% entre 00h00 y 06h00 -mañanas- y un insignificante 7.53% entre 06h00 y 18h00 durante el día. Esta evidencia sugiere un nicho de detección temporal para la nutria de mejillas blancas Africana en este ecosistema, lo cual constituye una verificación empírica en línea con su comportamiento conocido, críptico y nocturno.

SHORT NOTE

PRESENCE OF GIANT OTTERS (*Pteronura brasiliensis*) IN THE RÍO TORNO IN NORTHERN PERU

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Abstract: Listed as endangered by the IUCN Red List the importance of monitoring and assessing viable populations of Giant Otters (*Pteronura brasiliensis*) is at its top. A small area near the river Tapiche in the northeast of Peru was investigated for the occurrence of Giant Otters. Local people supported the project as field assistants. Otters were seen on 13 occasions and 8 individuals could be identified by their individual throat pattern and the locations of dens were marked in a map. This study confirms the occurrence of giant otters in the Torno area and highlights the importance of conservation efforts in this area.

Keywords: *Peruvian Amazon, Peru, throat pattern, individual identification*

INTRODUCTION

The Amazon Basin is one of the last places where giant otters are known to inhabit (Norris and Michalski, 2009). Giant otters live in social groups that range between 3-16 individuals, but it also varies with region, habitat and season (Carter and Rosas, 1997; Duplaix, 1980).

Giant Otters are classified as endangered according to the IUCN red list of threatened species and it is crucial to investigate and monitor the populations in the wild (Duplaix et al., 2008). The main threats for the survival of the species are habitat destruction, hunting and water pollution (Duplaix et al., 2008).

Giant otters can be identified individually by the cream coloured pattern on their throat (Carter and Rosas, 1997) serving as basis to produce an ID-kit of the group members. Recognizing individuals is essential when monitoring populations and investigating family constellations over time. Pickles et al. (2011) evaluated the use of camera traps in monitoring Giant Otter populations and found it was a useful tool to complement the observations by researchers regarding sexing the otters as well as determining activity patterns. Yet the conservation conflicts surrounding the giant otter (Duplaix et al., 2008) mean that population monitoring in isolation from the socio-economic context will be of little use for the conservation of this endangered species.

Previous studies show how education of the local population is as important as acute conservation efforts for the long-term conservation of giant otters (Norris and

Michalski, 2009; Michalski et al. 2012; Staib and Schenck 1994). Much of our understanding of the conservation challenges and solutions for giant otters comes from pioneering work in the Peruvian Amazon (e.g. Staib and Schenck 1994; Groenendijk and Hajek 2004). These studies show how there is no general conservation solution for giant otters and that conservation actions need to be developed and refined to fit with the local situation. In Peru the non-governmental organization "Chances for Nature" is supporting a small village in a remote area of the Peruvian rainforest to both protect the local biodiversity and develop sources of sustainable income for the local people.

The objective of this work was to investigate the presence of giant otters (*Pteronura brasiliensis*) in this area to support the NGO "Chances for Nature" for their conservation concession.

STUDY AREA AND METHODS

The Tapiche River is a tributary of the Ucayali River in the northeast of Peru near the Pacaya-Samiria National Park and around 120km south of the city of Iquitos.

The Torno is a small black water river and side arm of the white water Tapiche River. It is situated in the northeast of the Peruvian rainforest, south of the city of Iquitos and Requena (Fig. 1). The vegetation is rich with a high number of plant species i.e. *Astrocaryum chambira*, *Astrocaryum jauari*, *Mauritia flexuosa*.

The presence of Giant Otters was investigated for 10 days in July 2013 in the Torno area near a small community called Villa Buen Jesus de Paz (5°32'59.2" S, 73°50'32.7" W; Fig. 1)

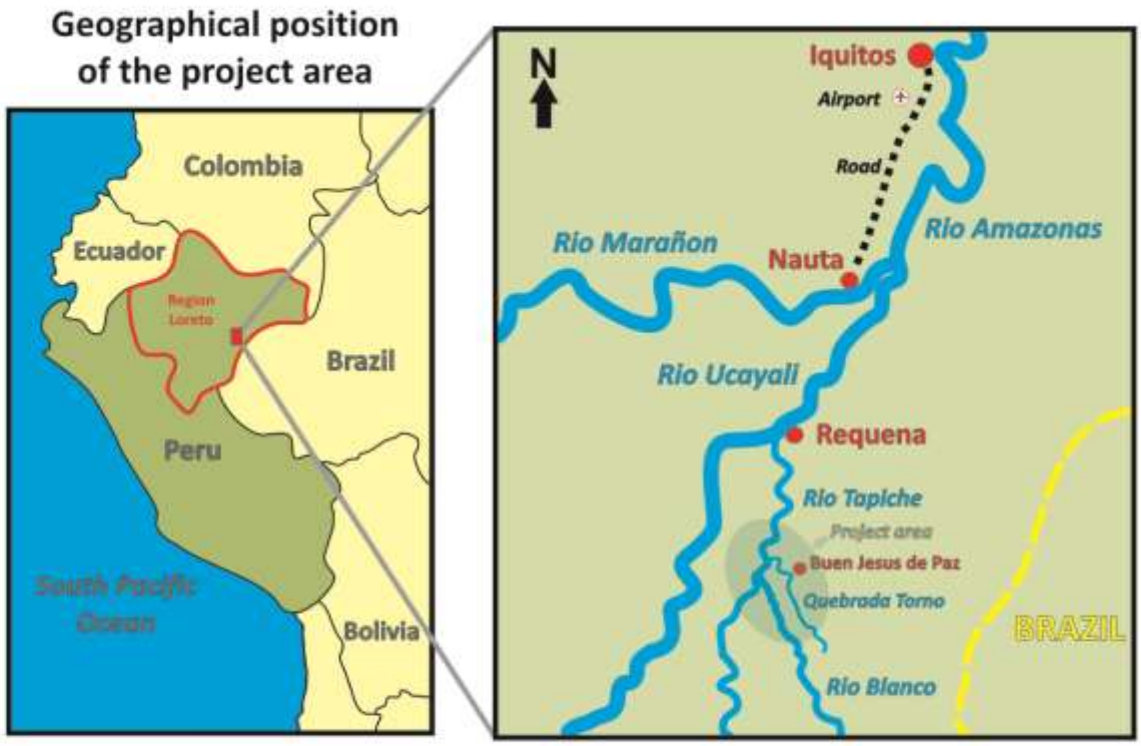

Figure 1: Project area at the Torno River

On 8 days a small wooden canoe with a paddle was used to look for the otters. On two days additionally to the paddle a motor was utilized to look for otters further along the river. It was only looked for otters between 7 am and 2 pm. A stop-at-first-sign approach as recommended by Groenendijk and Hajek (2004) where every sign of otter presence is noted was applied. When giant otters were seen, photos were taken with a Nikon D3100. The GPS (Garmin GPS e Trex) coordinates were noted as well as the time of day and the number of otters observed. Indirect signs of otter presence (i.e. dens, campsites with spraints and tracks) were also marked in the GPS. A local villager assisted with the canoe and to locate the otters.

The throat patterns were transferred into a mask sheet on which also the date and which otters were seen together were noted.

A camera trap (Maginon WK 1) was put up at two different times at one den and recorded for four and eight days, respectively. It was set to take three pictures and a video sequence of 10 seconds each time it was triggered. The interval between the photos was set to 3 seconds. As recommended by Utreras and Pinos (2003) the camera trap was set up at approximately 50cm above the ground.

The website www.geoplaner.com was used to visualize the GPS coordinates in a map.

RESULTS

Otters were seen on 13 occasions. Seven dens and five campsites along the river and oxbow lakes were marked in the GPS in a total of approximately 30km (Fig. 2). Based on the photos of the throat patterns 8 individuals could be identified, which were named according to the shape of the pattern (Fig. 3). Twice a group of about 8 otters was seen, but no throat pattern was completely visible. Juveniles were also present in this large group and some group members were also seen pairwise on some occasions.

Figure 2: GPS locations of Villa Buen Jesus de Paz (A) otter sightings (B), indirect signs (C).

A single adult was seen (Fig. 3.d) and cubs inside a den were heard on one occasion.

The camera trap reveals activity of the otters in the afternoon between 1:00pm-4:30pm (33 photos, 11 records). It also shows that the den was not visited every day, but with two days in between. The footage shows only one individual at a time, which prevents a proposition about group affiliation. No throat pattern could be identified, but one picture shows a male otter (identified from Dr. N. Duplaix Fig. 3). Local villagers reported the presence of giant otters along the Rio Blanco, a tributary of the Rio Torno (Fig. 1).

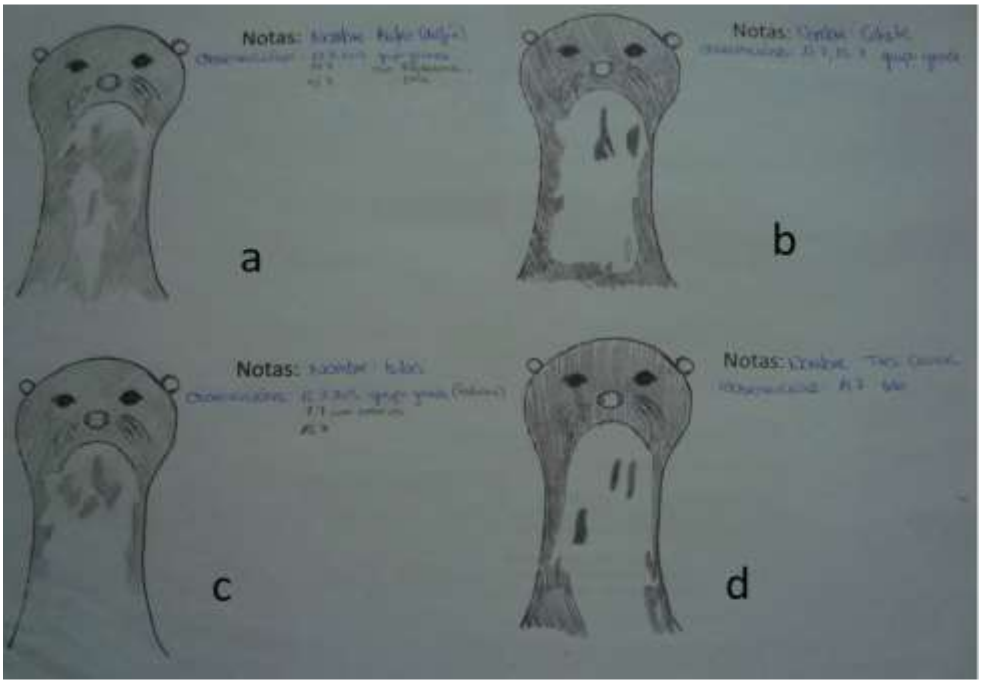

Figure 3: The mask sheet with the throat patterns of four Giant Otters.

Figure 4: Single male Giant Otter roaming around the den.

DISCUSSION

Since the species was classified as endangered in 2000 by the IUCN (Duplaix et al., 2008) it is even more important to undertake investigations of every viable population throughout South America. It is estimated that between 1000- 5000 Giant Otters exist in the wild (Duplaix et al., 2008). This study confirms the presence of at least one group of giant otters in the Torno area. The presence of different ages in the group indicates that the population is reproducing.

The sightings of pairs of otters which actually belong to a bigger group are supported by Rosas and de Mattos (2003). They reported subdivisions of family groups during foraging or escaping. Due to the sinking water level the otters used shortcuts over land to hide from the canoe. This may explain why some otters were seen in pairs which later showed up in the big group.

Pickles et al. (2011) argue that camera traps are a useful tool for supplementing observations made by researchers. Since no throat pattern was visible on the photos of the camera trap it may be useful putting up at least two camera traps at one location at different angles to increase the range of the camera and the possibility to get pictures of the throat or sex. Carter and Rosas (1997) recommend sustainable development projects and appropriately located protected areas to ensure the survival of the species. The identification of 8 individuals is a start to a long term monitoring project, which is planned to be carried out by the local villagers over the next years. The understanding of the local people for the importance of the study was limited, which supports the finding of Michalski et al. (2012) that education and the involvement of the local people from the beginning of a project is very important.

This study was one of the first projects in this area and the villagers are gradually becoming more and more involved in assisting the researchers and students. The inhabitants of the village formed their own organization called “Los Iwatzu” with motive to protect the area around their village including the rivers Tapiche and Torno. This study confirms the occurrence of giant otter in the Torno area and highlights the importance of conservation efforts in this area.

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RÉSUMÉ

PRÉSENCE DE LOUTRES GÉANTES (*Pteronura brasiliensis*) AU RÍO TORNO DANS LE NORD-EST DU PÉROU

Il est de la plus haute importance que les populations viables de loutres géantes (*Pteronura brasiliensis*), considérées “en danger” dans la liste rouge de l’UICN, fassent l’objet d’une évaluation et d'un suivi. Une petite zone près de la rivière Tapiche dans le Nord-Est du Pérou a été étudiée dans le but d’y recenser les loutres géantes. Pour ce faire, des assistants ont été choisis parmi la population locale. Des loutres ont été vues à 13 occasions. 8 individus ont pu être identifiés par les marques spécifiques de leur gorge et les emplacements de leurs tanières ont été notifiés sur une carte. Cette étude confirme donc la présence de la loutre géante dans la région de Torno, et souligne l’importance des efforts de conservation dans cette zone.

RESUMEN

PRESENCIA DE NUTRIAS GIGANTES (*Pteronura brasiliensis*) EN EL RÍO TORNO, NORTE DEL PERÚ

Listada como en peligro de extinción por la Lista Roja de la UICN, la importancia de monitorear y evaluar las poblaciones viables de Nutria Gigante (*Pteronura brasiliensis*) es altísima. Investigamos una pequeña área en el río Tapiche, nordeste de Perú, buscando Nutria Gigante. La gente local apoyó el proyecto como asistentes de campo. Fueron vistas nutrias en 13 ocasiones, y pudimos identificar 8 individuos por su patrón individual de coloración de garganta, y las localizaciones de las madrigueras fueron marcadas en un mapa. Este estudio confirma la ocurrencia de las nutrias gigante en el área de Torno, y resalta la importancia de los esfuerzos de conservación en esta área.

O S G M E M B E R N E W S

New Members of OSG

Since the last issue, we have welcomed 14 new members to the OSG: you can read more about them on the Members-Only pages.

Engedasew Andarge, Ethiopia: I have been working in the field studying anthropogenic impacts on wildlife since 2009. I am currently doing my PhD on "Population ecology, Genetic diversity and anthropogenic impact on Otters" in Ethiopia, where they have never been studied before. In the future, I plan to work with otter professionals to develop educational teaching materials about otter ecology and their conservation in Ethiopia.

Georgia Aragão, Brazil: I am a passionate biologist interested in Otters worldwide, and knowing more about their ecology is part of my job. I believe that transmitting information about the species is part of the conservation process.

Robert Aston, USA: As a young lad in the early 1970's, much of my "free" time was spent roaming the wilds of North Devon, UK, searching for the elusive "Tarka." Currently, with The River Otter Ecology Project in Northern California, I am involved with researching the resurgence, population densities, and familial connections, of the North American River Otter (*Lontra canadensis*), in the San Francisco Bay Area; and presenting to school, and other interested, groups.

Sabrina Bettoni, Brazil: I finished my MsC on Wildlife Biology and conservation and I am specially interested in otter's behaviour. I have been working with otters since May 2013 at the South America Otter Project (Projeto Lontra) - Brazil, I recently started a research on captive Neotropical River Otter's vocal repertoire.

Atul A. Sinai Borker, India: I work on Conserving Otter habitats in Goa, India and have been documenting the Otter activity in human modified landscapes. You can find the info about the work done on http://wildabs.com/otters-in-goa

Lori Li Fei, China: The otters of China are highly endangered, but there is no specific conservation action and even research currently being conducted for these animals. I'm trying to locate remaining populations in southern China using camera trapping and interview surveys, so that we could start implementing conservation actions.

Lauren Harrington, UK: I have been a researcher at the Wildlife Conservation Research Unit at Oxford University for almost 18 years, working predominantly on mustelid related issues, mostly in the UK, including American mink control, interactions between American mink and native mustelids, and the diving behaviour of mink. My main research focus at the moment is otter-fisheries conflict, and the potential use of acoustic deterrents.

Megan Isadore, USA: Megan is a Co-founder of The River Otter Ecology Project , the first project to research the recovery and ecological niche of river otters (Lontra canadensis) in the San Francisco Bay Area of California, USA. The project combines citizen science and focussed research to discover basic population, range, seasonal prey preferences, dispersal habits and family relationships among river otters in the Bay Area, using noninvasive methods. ROEP also provides public education for both adults and children on the importance of restoration and conservation of watersheds, using river otters as a charismatic ambassador.

Lucy Mead, United Kingdom: I am Secretary of the Somerset Otter Group and have worked for James Williams for the last 7 years. Although not an otter expert I have acquired knowledge of the otter through working with James. The Somerset Otter Group currently has 125 members who assist in surveying the County.

Julio Moscoso Sánchez, Chile: I am a marine biologist, and work on the conservation of Marine Otters Lontra felina off the coast of San Vicente Bay, Biobío, Chile for Ecogestión Ambiental Ltda.

Vasantha Nugegoda, Australia: I design exhibits for zoos and private developers in England, the Middle East and Singapore. I was formerly in charge of animal management in Singapore's Night Safari and the coordinator for Singapore native animal reintroduction group. I am a member of the Animal Reintroduction Group and a scientific Fellow of the Zoological society of London.

Jason Palmer, UK: Jason Palmer is the animal manager for the New Forest Wildlife Park. Currently responsible for over 40 otters of four species, both captive and wild rehabilitated, managing possibly the largest collection of otters in the UK or Europe.

Jo Pearse, United Kingdom: I am the secretary of the Somerset Otter Group, a county wide group of enthusiasts surveying for otters and undertaking various project work. Importantly, we conduct a two day survey across the county each year, providing a snap shot of most of the otters from fresh spraints. I will be co-ordinating this in 2015.

Rogério Vieira, Brazil: I work at Ekko Brazil on the rescue, treatment and recovery of wild otters, and I research on the management and maintenance of otters in captivity

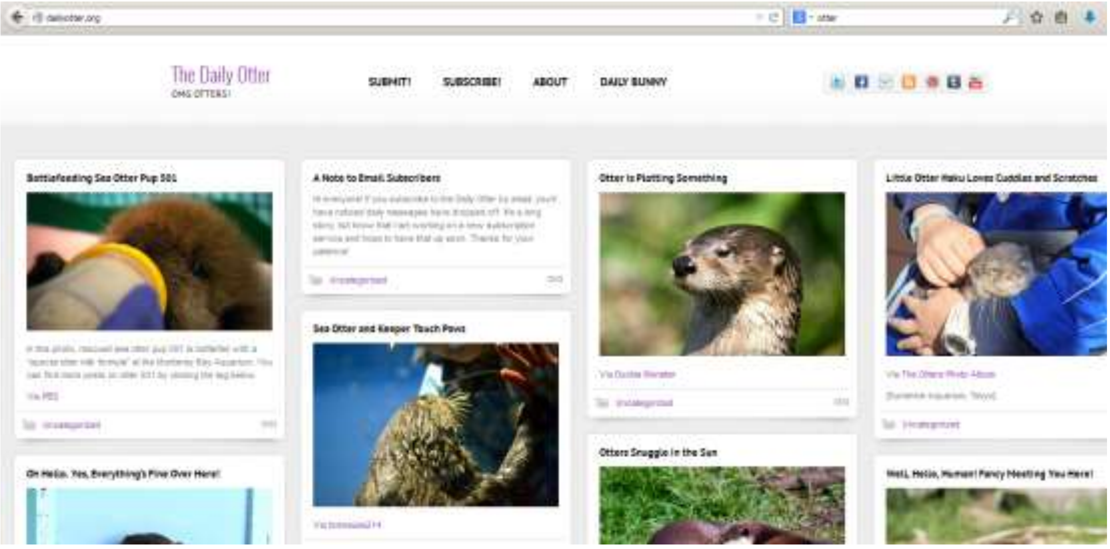
Dave Webb, United Kingdom: I am a keen wildlife photographer, living on Exmoor. My true passion are otters and I am very keen to change peoples views on these animals; I am totally dedicated to the education to further the wellbeing of otters. I chair the UK Wild Otter Trust , a relatively new organisation seeking to promote a positive understanding of the Eurasian Otter and its conservation in all areas to as many people as possible and to raise the awareness through education, involvement and information.

In addition, we are happy to welcome **Sabine Stolzenberg**, formerly a student member, as a full member of OSG.

VIRTUAL OTTERS

Things from around the internet that caught the Editor's eye!

The Daily Otter
http://dailyotter.org/



Swimming Otters

http://www.arcademics.com/games/swimming-otters/swimming-otters.html

SCREEN SHOT OF THE MONTH

http://ilovenelson.com/business-profiles/otter-books/

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