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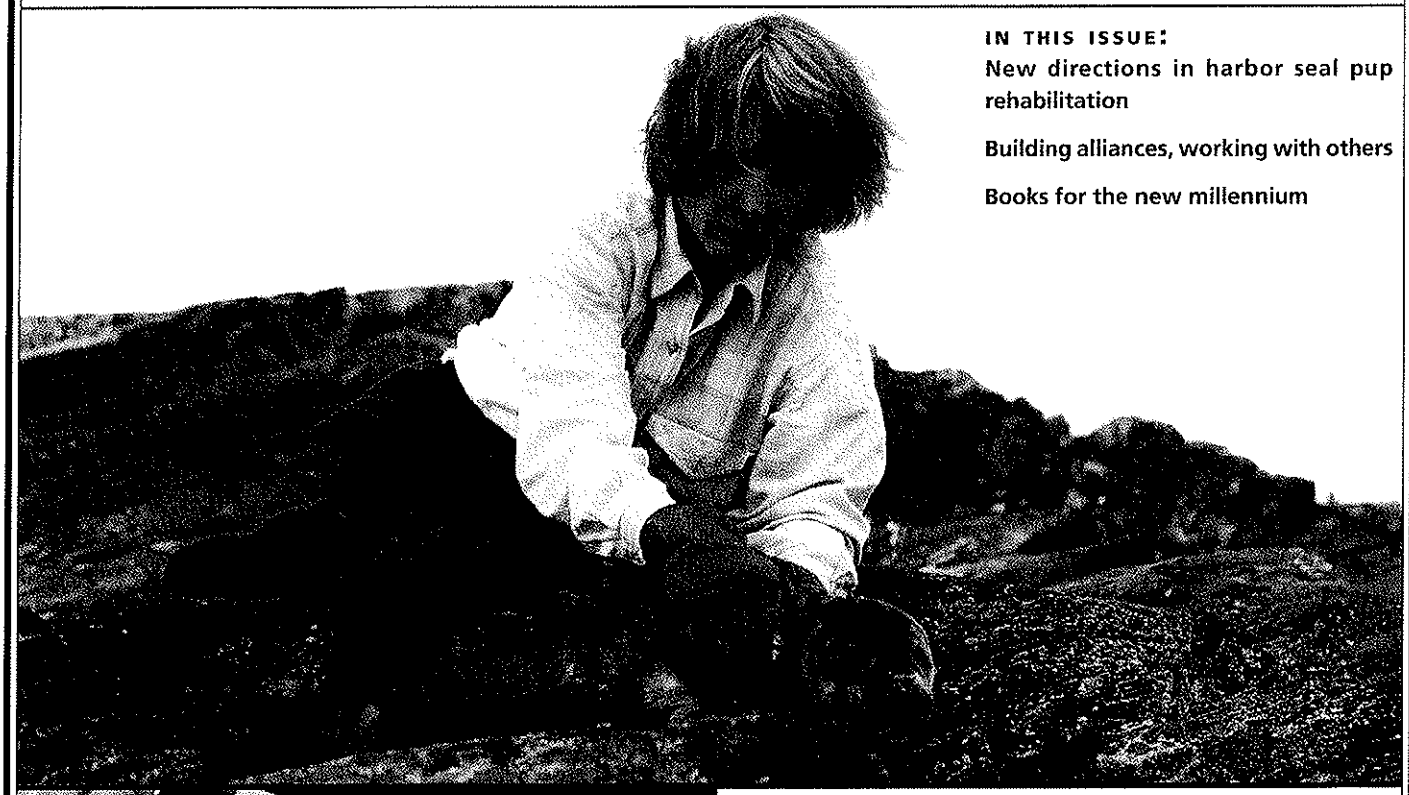
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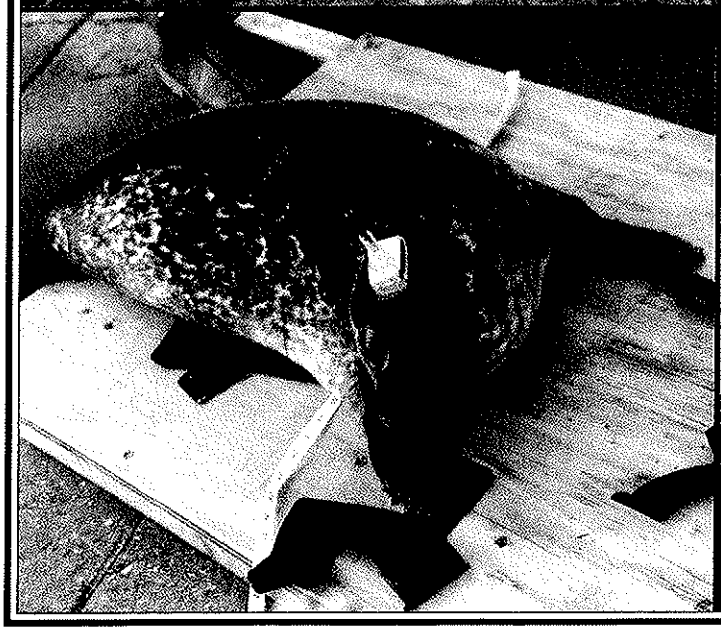
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New directions in harbor seal pup rehabilitation

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ABOUT THE JOURNAL . . .

THE JOURNAL OF WILDLIFE REHABILITATION is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species, with the ultimate purpose of returning them to the wild. The *Journal* is published by the International Wildlife Rehabilitation Council (IWRC), which invites your comments on this edition. Through this quarterly publication, rehabilitation courses offered in numerous locations, and an annual conference, IWRC works to disseminate information and improve the quality of care provided to wildlife.

ON THE COVER: NEW RESEARCH IN HARBOR SEAL PUP REHABILITATION. (Top) Susan Wilson rescues Cecilia, an emaciated, postweaning pup, from her haul-out site in County Down, Northern Ireland. [Photo: Brian Black] (Bottom, left) Tara, an abandoned newborn pup who was rescued and reared in a captive environment, is measured and fitted with a radio-tag just prior to release. [Photo: Susan C. Wilson] (Bottom, right) Tara, almost four months after her release. [Photo: Susan C. Wilson] BELOW: Cecilia was fed a high-fat/high-protein liquid diet during rehabilitation. [Photo: Susan C. Wilson]



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EDITORIAL

Important Work Ahead

Five and a half years ago, I knew little—beyond what "everyone" knows—about wildlife, the many threats these animals face, or the seemingly countless caring people who work long and hard on their behalf. Then I took a job as publications manager at the Peninsula Humane Society, a large animal shelter in the San Francisco Bay Area.

In 1974 PHS had taken the then unusual step (for a shelter) and opened a wildlife rehabilitation department. By the time I arrived, the wildlife center was very busy caring for thousands of animals a year—from raccoons to frogs, from snakes to raptors, from sea birds to song birds, from raccoons to the rare caiman. The wildlife hotline logged more than 6,000 calls annually, educating the public how best to coexist peacefully with their wild neighbors.

Five years of watching the wildlife care team at PHS taught me a lot, and today I have tremendous insight into and respect for the work rehabilitators do. Working often long hours with typically tight resources, you save individual lives and advocate on behalf of whole populations. You educate yourselves so that you can inform and educate others—politicians, neighbors, and community boards included—about the dangers of relentless development, habitat destruction and fragmentation, pollution, and simple ignorance about other species and how they live.

I am very, very happy to be the new editor of your *Journal*. For me, it's a rare opportunity to apply my professional skills and background in a field that I know is not just interesting or important, but that is *vital* in the most basic sense of the word.

I'm hoping that we have a long and productive relationship. By this I mean, of course, that I encourage and welcome your input. If you've got research or news to share, please contact me. Whether you'd like to write a substantial case study or review a wildlife-related book, I'd love to hear from you. I hope you will submit your "simple solutions" to common rehab problems, and that you'll join the voices sharing ideas, information, and insight in our regular Up For Discussion section. With your contributions and feedback, we can make this *Journal* better and better with each issue. More important, by sharing your knowledge and experiences you can help so many more animals than "just" those who receive your direct care.

This issue of the *Journal* features three significant studies on harbor seal pup rehabilitation and tracking by lead author Dr. Susan Wilson, field team coordinator for an international ecotoxicology project with the World Bank Caspian Environment Program. For readers less familiar with harbor seals, Dr. Wilson has also written an introduction that discusses the natural history of these animals and provides a backdrop against which the studies can be read and understood.

All IWRC members, whether involved in harbor seal pup rehabilitation or not, will surely benefit from the careful methodology that these studies exhibit. Whichever area we work in, it's always important to periodically evaluate not just what we do, but how we do it. These studies can serve as useful guides in showing us how.

Marianne Skoczek
Editor

Overview of Harbor Seals, Their Behavior, and Previous Rehabilitation Attempts:

An Introduction to Seven Case Studies of Harbor Seal Pup Rehabilitation and Tracking after Release

by Susan C. Wilson

The seven case studies of post-release rehabilitated harbor seal pups, carried out in County Down, Northern Ireland, presented here were undertaken to compare the pups' progress and behavior with that of wild pups weaned naturally in the same population. The studies arose out of a concern that if harbor or grey seal pups are retained in their rehabilitation facility for three or more months, as is typically the case, their chances of survival and normal behavior may be reduced because they are unable, in the captive environment, to go through the normal stages of development and learning experienced by wild pups of this age. The following catalogue of behaviors and developmental patterns of wild harbor seal pups has particular relevance to the rehabilitation of newborn or preweaning stranded harbor seal pups and provides important background for understanding the studies.

Preweaning

The lactation period usually lasts three to four weeks (Wilson 1974; Muelbert and Bowen 1993). Pups weigh about 11 kg at birth and are weaned at an average of 25 kg on Sable Island, Canada (Muelbert and Bowen 1993). The mother's milk contains 45% fat, 9% protein, 0.2% lactose and 45% water (Harrison 1960, cited by King 1983). The daily weight gain may be as much as 0.6 kg/d (Bonner 1989). The mother appears to wean her pup by abandoning it at the haul-out site (Wilson 1974; Wilson and Corpe 1996).

Throughout the lactation period, pups swim and dive with their mother in the shallow waters surrounding their natal site and haul-out with her in the company of other seals (Wilson 1974; Wilson and Kleiman 1974). During this period they therefore become locally orientated, experience seal responses to tidal and diurnal rhythms, and participate in the social haul-out.

Pups apparently do not accompany their mothers on feeding dives. They are either (from about two weeks of age) left by the mother at the haul-out site and later reclaimed by her or they are taken with her, but left sleeping on the surface while she makes repeated dives (Wilson 1974; Wilson and Corpe 1996). So far as is known, the mother does not teach her pup to catch prey; the pup does not at this stage have the opportunity to watch its mother do so, and the mother does not give her pup any fish she has caught. Muelbert and Bowen (1993) found from stomach lavage that milk and solid food were never found together in the stomach and concluded that weaning is abrupt in the harbor seal. At weaning, therefore, the pup has probably experienced neither fishing nor eating of fish, and has had only its mother's milk.

During the lactation period pups socialize almost exclusively with their mother. Immediately after birth, mother and pup nose each other intensively in the nose, head, and neck region and continue to do so less intensively throughout the lactation period while swimming around the haul-out site and playing with each other. Pups do not socialize with one another until close to the time of weaning (Wilson 1974; Wilson 1978; Wilson and Kleiman 1974).

Postweaning

After weaning, pups begin to follow both one another and other seals, often to the haul-out rock where they cluster together (Wilson 1978; Wilson and Corpe 1995). In Maine, U.S.A., pups were observed to return in small groups to the haul-out rocks from the sea and engage in synchronous diving in a manner that suggested foraging (Wilson 1978).

A study in northeastern Ireland of five pups radio-tagged at three to four weeks of age at their natal haul-out site indicated that during the next three weeks the pups dived in the area immediately surrounding that haul-out site and less than 2 km offshore. Over the following weeks they dispersed to individual foraging areas along the coastline adjacent to the haul-out site, extending up to 40 km along the coast in either direction and up to about 10 km out to sea. Each pup remained in the vicinity of their selected foraging area for several weeks at a time. Because they were only rarely located at that or other haul-out sites during that period, they were presumed to sleep at sea (Wilson and Corpe 1996). Only one of the five pups in this study was thought to have eventually dispersed from the study area at about 10 weeks of age. This finding is consistent with an Orkney study, in which the majority (80%) of 29 nursing pups fitted with plastic numbered tags were found within 50 km of their nursing site, while only six dispersed more than 100 km away.

Pups may begin to feed as soon as three days after weaning. On Sable Island, 10% fed within three to five days of weaning, 70% were feeding after 14 days, and the remaining slowest pups were feeding by 23 days (Muelbert and Bowen 1993). Prey items from pups at this stage are very tiny. Pups aged one to three months on the East England and Dutch coasts have fed largely on shrimps (Sergeant 1951). Golítsev (1972) reported finding small crustacea such as amphipods and decapods, and small fish, such as sand eels, from pups of five to eight weeks of age, while the initial postweaning diet of pups from

Sable Island consisted of very small prey, such as 6–7 cm sand eels and hake, as well as shrimp (Muelbert and Bowen 1993). Two pups aged about six weeks from County Down (including pup 9 of the present studies) were found to have been eating tiny gadoid fish of about 7 cm in length.

Pups aged four to six months in Northern Ireland were found (from fecal analysis) to be eating mainly gadoid fish and flatfish up to 30 cm long, i.e., of the same size as taken by adult seals from the same haul-out site (Wilson and Corpe 1996).

A study of diving behavior in pups aged two to four months found that dive duration was positively correlated with weight and length, but that although pups are so much smaller than adults (a quarter or less body weight), within one month of weaning they were able to exploit food resources in the same areas as adults (Corpe et al. 1995). These authors found that the median dive time for wild pups of 30 kg body weight diving in waters up to 30 m depth was about 105 s (cited by Wilson and Corpe 1996).

During the postweaning fast, harbor seal pups on Sable Island lost about 5.2 kg (about 21% of their weaning body weight) over the first five weeks of the postweaning period, even though they were beginning to feed. Their total body fat was about 33% at weaning, but only about 12% at 40 days postweaning (Muelbert and Bowen 1993). These authors emphasize that the postweaning delay in feeding is due to feeding techniques having to be learned during this period.

From this catalogue of wild pup physical and behavioral development, the problems facing pups released after three to four months or more in an aquarium are readily apparent. They will have missed the opportunity during the first three weeks after weaning (i.e., up to six weeks of age) of exploring their postweaning area; learning about haul-out and tidal rhythms; learning to catch very small prey, probably in the littoral and sublittoral shallow water; and integrating socially with other pups and older seals in the haul-out.

Over the next few weeks they will have missed the opportunity to disperse locally, establish individualized (or possibly group) foraging areas offshore, and learn to dive to 30–40 m for selecting and catching suitable larger prey. It is important to emphasize that wild pups undergo this critical developmental stage between three weeks and three months of age. The harbor seal pupping season—in Northern Ireland and at least some other regions—is generally well synchronized, with most pups being born over a two- to three-week period (Wilson 1974, 1978; unpublished data), so most of the pups of the year in such a population will go through the stages of postweaning development at more or less the same time.

By the time rehabilitated pups are generally released, at three to four months of age or more, the wild pups are geographically orientated, are socially integrated, have learned to feed via several stages, and—at least in the County Down population—have established offshore foraging areas. The older seals in the British Isles populations have completed their postbreeding season molt by late September and the County Down seals are less in evidence at inshore haul-outs. There will therefore be few "guides" for the rehabilitated pups to follow and imitate. The rehabilitated pups will be not only "uneducated" and disorientated, but their diving potential may be impeded by positive buoyancy due to excess body fat and inadequate muscle development. They may also have to unlearn the behavior patterns associated with seeking and feeding on already dead fish, as learned during the months of rehabilitation.

Observations and discussion of rehabilitation procedures at various facilities in Britain, Ireland, and the Netherlands suggest to this author that rehabilitated pups are usually retained for three to four-plus months before release due to:

- the difficulty of developing an artificial feeding formula that simulates the high-fat content of seal milk and allows pups to grow sufficiently fast to be released close to the natural weaning period;
- misapprehension by many rehabilitation establishments concerning the natural parameters and timetable of pup development; and
- commercial considerations (e.g., it may be "desirable" to retain pups in aquaria for public viewing).

The following case studies (and repetition of such studies in the future) begin to tackle the following questions:

1. What are the postrelease behavior patterns and survival records of pups retained in rehabilitation centers for three or more months? How does their behavior differ from that of wild pups from the same population?
2. Can a high-fat liquid formula, which can be digested by pups and fed exclusively until their release, be developed so that the pup growth rate in rehabilitation may approximate that in the wild?
3. Can a rehabilitated pup, stranded at the nursing stage (usually less than one week of age) and released at about one month of age, survive?
4. Can a rehabilitated pup, stranded sick or starving in the immediate postweaning stage (generally three to six weeks) and released as quickly as possible after medical treatment is complete and given only a minimal nutritional boost, survive?

The seven case studies reported here were intended to address these questions, which will be discussed in the Postscript that follows the case study reports.

Note: References for this Introduction are given following the Postscript, on page 25.

ABBREVIATIONS USED IN THESE STUDIES

s	seconds
min	minute
hr	hour
d	day
kg	kilogram
m	meter
km	kilometer
n	number
ml	milliliter

Radiotelemetry Study of Two Rehabilitated Harbor Seal Pups Released Close to the Natural Time of Weaning in the Wild

by Susan C. Wilson

ABSTRACT: Two newborn harbor seal pups in County Down, Northern Ireland, were found abandoned in 1997. Both pups were reared in a captive environment on an artificial formula intended to simulate the constituents of natural seal mothers' milk, with the intention of releasing the pups as close as possible to the natural time of weaning in the wild.

The pups grew steadily, each achieving an 11 kg weight gain in approximately one month. In early August each pup was fitted with a head-mounted VHF radio-transmitter and released at Millin Bay, County Down. Subsequent radio-tracking revealed that both pups survived, and one of the pups was occasionally seen until the end of the following May. Both pups foraged over an area of about 15 km radius, within the usual range previously found for wild harbor seal pups tagged locally.

KEY WORDS: Harbor Seal, Pup Rehabilitation, Postrelease, Behavior, Survival

SUSAN C. WILSON, BSc, MSc, PhD, LLM Since earning a degree in zoology at Glasgow University in 1967, Dr. Susan Wilson has carried out behavioral ecology studies of different species of voles and caviomorph rodents as well as on harbor and grey seals. Her research interests initially concerned the development of social behavior in mammals, specializing in olfactory communication and parent-infant and inter-juvenile relations. Her seal studies began with different populations in Scotland and Northern Ireland and then extended to Sable Island, Canada, and Maine,

(Author biography continued on p. 6)

This study of the rehabilitation of two stranded harbor seal pups (*Phoca vitulina vitulina*) aimed to (1) enable the pups to gain weight rapidly by feeding them a formula intended to simulate as closely as possible the harbor seal mother's natural milk, (2) release the pups as close as possible to the natural time of weaning, and (3) follow by radiotelemetry their postrelease progress at sea.

Rehabilitated harbor seal pups are usually not released until they are at least four months of age, and sometimes considerably later, at about 25–30 kg (Morgan et al. 1993; Picken 1978; Wilson and Johnston 1999; B. Price, pers. comm.). This is therefore at least three months later than the natural time of weaning at three to four weeks of wild harbor seal pups in the U.K. (Venables and Venables 1954; Wilson 1974; Wilson in prep.; Cook and Borelli 1993). Attempts to monitor the progress of such rehabilitated pups after release have indicated some successes, but also some differences in behavior from the norm (Picken 1978; Morgan et al. 1993; Wilson and Johnston, 1999, Tougaard 1996).

After natural weaning, wild harbor seals tend to congregate with other pups and young juveniles (Wilson and Corpe 1996) and within one to two weeks begin to feed on tiny inshore fish (Muelbert and Bowen 1993; Wilson, unpublished data). For the next two to three months they have been found to establish favorite foraging areas in local coastal waters (Wilson and Corpe 1996). The present study's aim to release rehabilitated pups as early as possible was motivated by the hypothesis that they would be likely to integrate most successfully back into the local population if they were given the opportunity to engage in the normal developmental phase for postweaning pups. Their progress after release was therefore monitored by VHF radiotelemetry.

Rescue and Initial Condition

Two newborn harbor seal pups were found abandoned in July 1997 in County Down, Northern Ireland (Table 1).

Pup 10 (Tara) bore a fresh three-inch umbilical cord and appeared healthy despite being extremely small. At one week of age she was given a worming medication by subcutaneous injection of 1% Moxidectin (Cydectin). Pup 11 (Caolan)

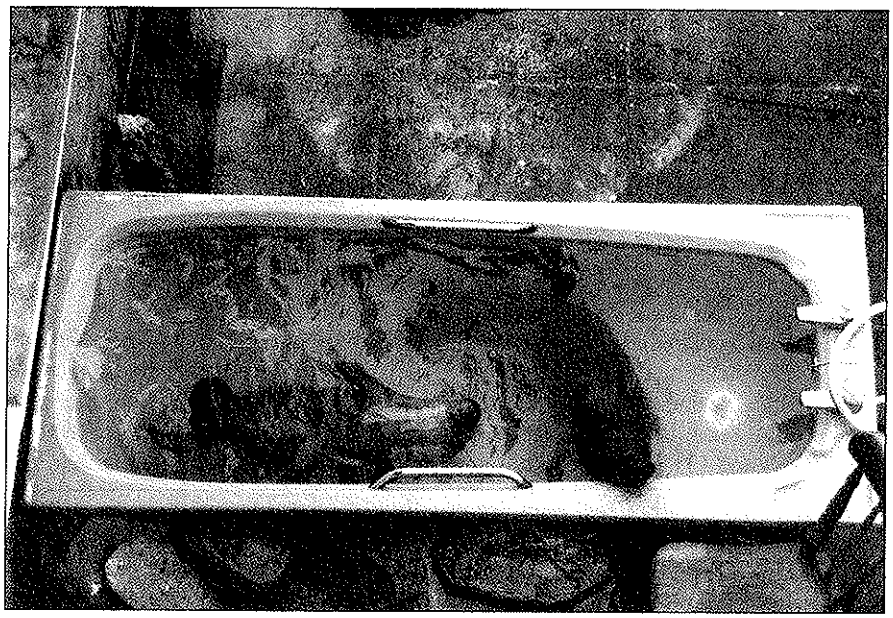
TABLE 1. INDIVIDUAL PUP DATA

Name	Tara	Caolan
ID no.	10	11
Gender	female	male
Rescue date	03JUL97	15JUL97
Location	Tara, Millin Bay	Ringboy Point, Minerstown
Weight	8.0 kg	7.5 kg
Estimated age	0–1 days	4–7 days

(continued from p. 5)

U.S.A., during a 12-year association with the Smithsonian Institution at the National Zoological Park. In 1989 she joined a research project on harbor seals in northeast England and subsequently established the ongoing Tees Seals Monitoring program. In 1994 she began a two-year research project on harbor seals with the Northern Ireland Environment & Heritage Service. Her current research interests on seals include behavioral development of pups, breeding ecology, diet and accumulation of toxic contaminants. Dr. Wilson recently completed a degree in environmental law. She is currently field team coordinator for an international ecotoxicology project with the World Bank Caspian Environment Program.

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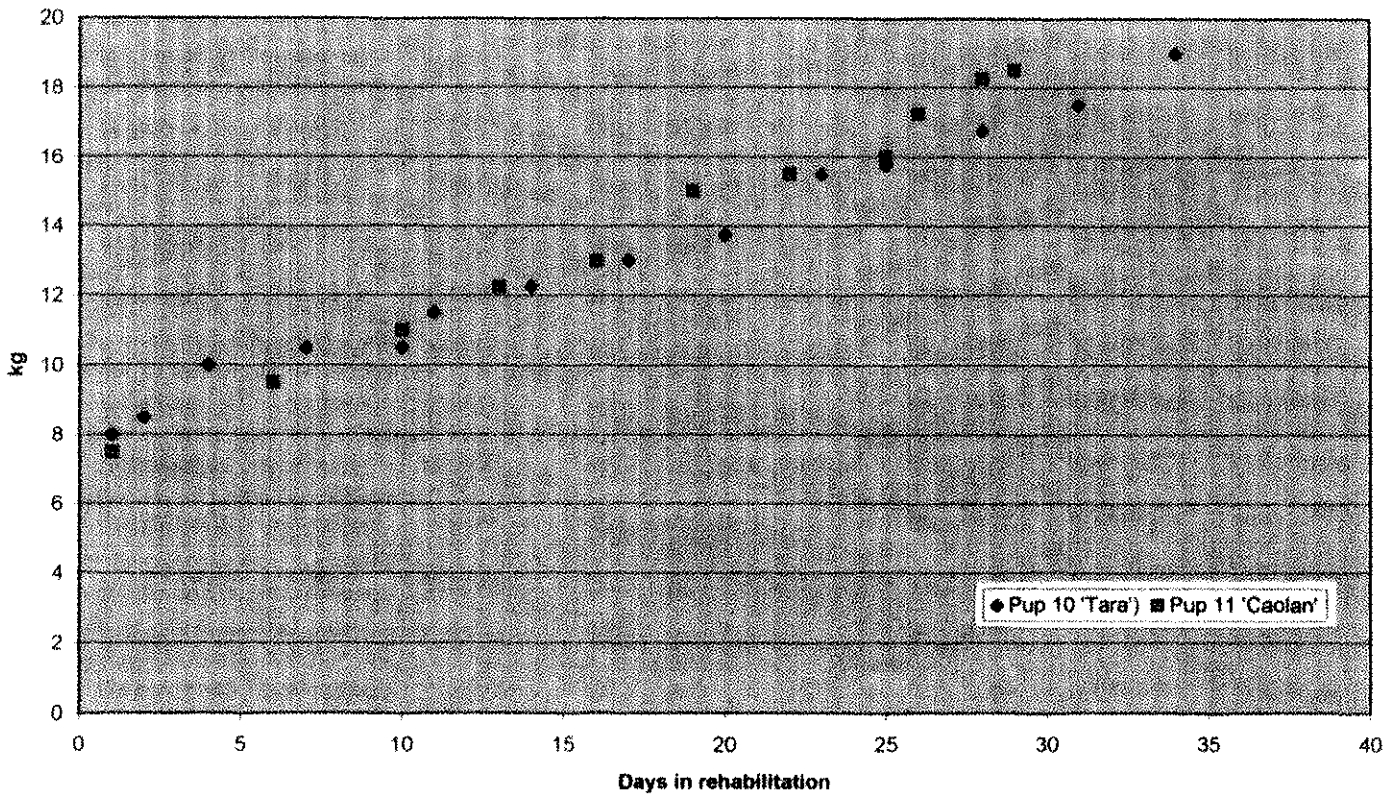


SUSAN C. WILSON

FIG. 1 Both pups (Caolan, left; Tara, right) enjoying the bath in their rehabilitation pen in late July.

had no remaining cord, but an infected umbilicus. He was extremely emaciated (Table 1) and had an elevated temperature for the first week, during which time he was maintained indoors in a dry bath. He was treated with antibiotics by subcutaneous injection of enrofloxacin (Baytril) followed by a week's course of orally administered Trimethoprim/Sulphadiazine (Trimedoxine) and worming medication, and was under the care of a veterinary surgeon. The pups were weighed every two to three days using bathroom scales.

FIG. 2 Weight gain by Tara and Caolan during rehabilitation.



Rehabilitation Environment

Both pups were maintained until their release in an outdoor pen, approximately 3 m square, located beside the seashore. There the pups had access to shelter and a bath filled with tap water (Fig. 1).

Feeding

Both pups were fed through a stomach tube of 7 mm internal diameter. They were fed at approximately 4 hr intervals between 8 am and 1 am, usually five (occasionally four) times a day. The volume of the formula started at 200 ml per feed and was gradually increased to 350 ml after eight days and to 400 ml shortly before release.

The formula was constituted from Zoologic Milk Matrix 30/55[1] (minimum 55% fat and 30% protein powder formula) made up in warm (previously boiled) water so that it was just liquid enough to run through the tube; fresh or canned fish (usually herring or mackerel, respectively); and cream, all liquefied together in a blender, in the approximate volumetric ratio of 5:1:1, respectively, for a 350 ml feed. To this mixture was added a teaspoon of cod liver oil and, just before feeding, digestive enzymes (approximately 2/3 of a single dose tablet for a human adult), including lactase, lipase, and protease.[2] The formula was adjusted to approximately body temperature before feeding. The pups were fed exclusively on this liquid formula until their release.

Growth of the Pups Prior to Release

Both pups gained weight at a similar steady rate averaging about 0.33 kg/d (Fig. 2), achieving a total weight gain of approximately 11 kg in 33 days (Tara) and 28 days (Caolan). This weight gain enabled the pups to be released on August 6 and 11, respectively, at approximately 18–19 kg.

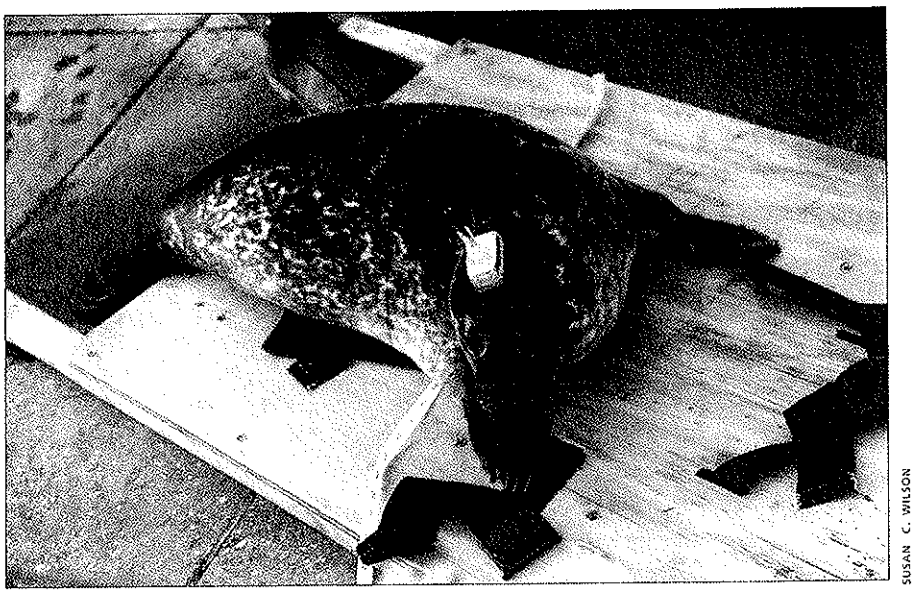


FIG. 3 Tara released from the straps of the restraining board, immediately after tagging and measuring (6 August 1997).

Fitting of Radio-Tags and Release

A VHF transmitter with a flexible antenna of approximately 27 cm[3] was fitted to each pup before release. The tag was glued to the fur on the top of the head whilst the pup was lying on its ventral surface and secured to a restraining board (Fedak, Anderson, and Curry 1983). A fluorescent dye mark was also applied to the fur of the back (Thompson 1989), and standard length and maximum girth were measured (Table 2; Fig. 3). On this occasion a roto-tag was not applied to a hind flipper, but otherwise the tagging method was the same as in the earlier studies of harbor seal pups in County Down (Wilson and Corpe 1996).

Following the tagging procedure, each pup was allowed to settle again in the pen and was also fed again. Tara was released on 6 August by being led down to the sea from the pen. She was free to return to the pen if she so chose. Caolan was released on 11 August by being allowed to follow Tara toward the shore. The pen was then left open for either pup to return at will.

Radio-Tracking Pups After TR2 Release

The pups were tracked using a TR2[4] VHF receiver and Yagi aerial. Tracking was carried out at least twice a week from the time of release until the end of October (apart from a break between 1 and 11 September). Each of the two frequencies was listened to for 7 to 10 min at a number of vantage points along the coast (Fig. 4). Two or three fixes on the signal were then obtained using the null-average method (Springer 1979).

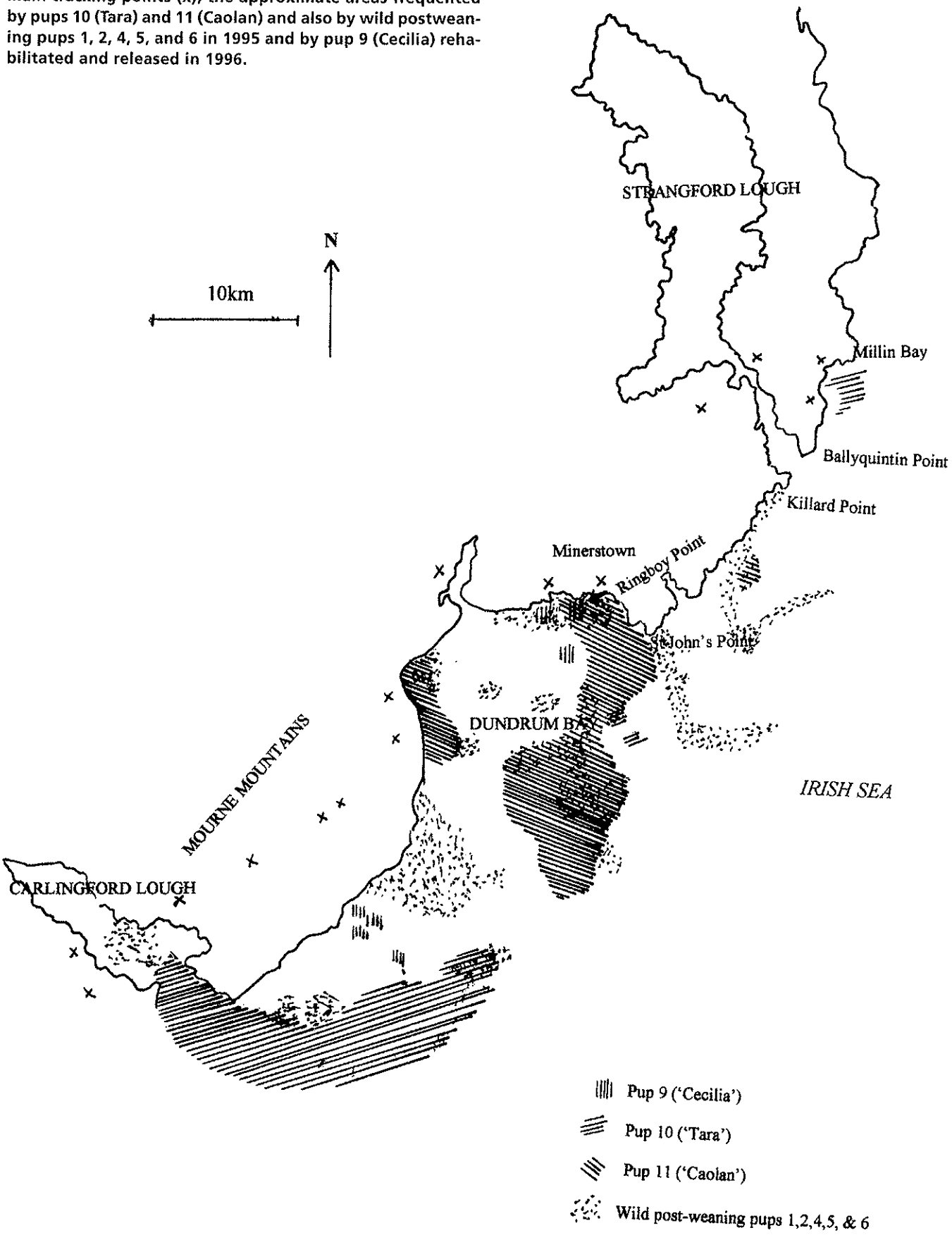
Pup Behavior Immediately Following Release (6–20 August)

Between 6 and 14 August Tara remained in Millin Bay and returned voluntarily to the pen at least once a day. Immediately on her return, the two pups would reunite by playing together

TABLE 2 RADIO-TAGGING AND INITIAL RELEASE

Name	Tara	Caolan
Date	06AUG97	14AUG97
Weight	19.0 kg	18.5 kg
Length (nose-tail)	89.5 cm	93 cm
Girth	69 cm	69 cm
VHF frequency	173.872.5	173.732.5
Paint mark	T	C

FIG. 4 Map of the County Down coast from the Millin Bay rehabilitation site south to Carlingford Lough showing the main tracking points (x), the approximate areas frequented by pups 10 (Tara) and 11 (Caolan) and also by wild postweaning pups 1, 2, 4, 5, and 6 in 1995 and by pup 9 (Cecilia) rehabilitated and released in 1996.



in the bath. Tara then stayed in the pen for 8–15 hr, generally having three feeds at the usual 4 hr intervals, before returning of her own volition to the sea. During this period she maintained her weight at around 19 kg.

After being tagged on 11 August, Caolan voluntarily remained in the pen until 14 August, when he was taken into the sea in the company of Tara. During the rest of the day the two pups were observed swimming in the bay and interacting with each other, surfacing and submerging simultaneously. Caolan did not return to the pen. Tara continued to return for a feed once a day, but feeding was discontinued on 17 August. Both pups remained in Millin Bay until 20 August, although neither was seen to join the other harbor seals (about six to eight adults) at the Millin Bay haul-out rocks during this period.

During Tara's first day of freedom her dive times increased from an initial average of 15 s (n=16 at 1950) to 22 s (n=10 at 2045) to 45 s (n=20 at 2133). By the second day her average dives were longer than 1 min with a maximum of 107 s (n=12). Caolan's average dive time on his first day was 32 s with a maximum of 101 s (n=19), and 71 s on his second day (n=24) with a maximum of 162 s. Thereafter their average dives in Millin Bay were usually more than 1 min (56–81 s averages for Tara [total n=47 from 11 August] and 41–96 s averages for Caolan [total n=38 from 16 August]).

Movements of the Pups from 20 August to 31 October (Fig. 4)

Both pups departed from Millin Bay for the first time on 20 August. On that day diving signals were obtained from Caolan from off Ballyquintin Point. However, the signals received from Tara indicated that she was traveling rather than diving and in the evening she was found to be in the vicinity of the mouth of Strangford Lough, still apparently traveling.

On 22 August Caolan swam into the shore beneath the pen and then departed on a southeast bearing. On 23 August he was detected offshore from St. John's Point. No signal was obtained from Tara until 29 August; at 19:00 she was detected returning towards Millin Bay from a southeast direction and swam straight into the shore below the pen. She was found to weigh only 15 kg and was given a single feed of milk formula, after which she immediately returned to sea. On 30 August she remained in Millin Bay, where four dives of between 90 s and 4 min were recorded, but by 1 September she had again departed from Millin Bay.



SUSAN C. WILSON

FIG. 5 Tara at Millin Bay, just below the rehabilitation pen (17 September 1997).

Signals were received from Caolan on 15/20 tracking attempts during September and October. He remained mainly in Dundrum Bay, in an area roughly 15 km radius, where he was found to be hauled out (at Minerstown) on two occasions in late October.

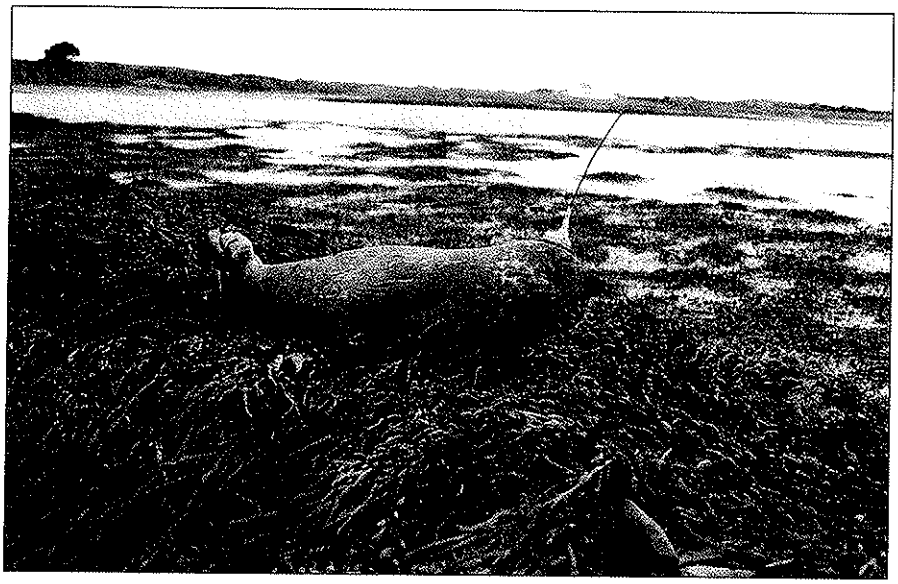
Tara was detected on 13/15 tracking attempts along the Dundrum and Mourne coast, when her range was found to be approximately 15 km radius from the mouth of Carlingford Lough northwards off Kilkeel, about 60 km south of Millin Bay. She was also located in Millin Bay on four different occasions, always at a weekend (27/28 September; 10/12, 18/19, and 26/27 October). She hauled out alone on intertidal ledges in the bay. Tracking her just after this and subsequent visits revealed that she returned immediately to the Kilkeel area each time. She was found to make the journey in either direction in a few hours and did not "stop off" en route. On her first visit at the end of September she was estimated visually to be at least 20 kg (Fig. 5) and from the end of October her weight was estimated to be at least 25 kg [5] (Figs. 6 and 7).

On 30 November Tara was seen for the first time to haul out on the traditional haul-out rocks in Millin Bay in the company of three adult harbor seals. On 1 February 1998 she was seen with a small bald patch where the transmitter had been attached (Fig. 8). She was last seen and identified on 24 May 1998.

Discussion

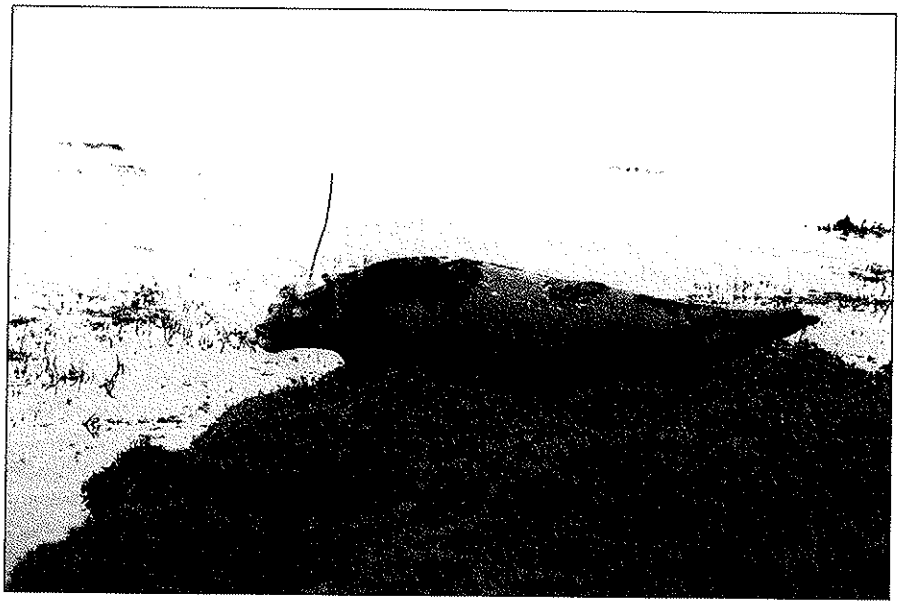
Weight gain during rehabilitation: The formula fed to both pups resulted in a fairly steady weight gain of about 0.3 kg/d. Although this is considerably less than an estimated average of 0.6 kg/d in the wild (Bonner 1989), it is nevertheless slightly greater than so far achieved by other rehabilitators using a Milk Matrix–based formula with other additives (Ticheler et al. 1999). The extra weight gain in this study may therefore have been due, at least in part, to the use of the enzyme additives, which may have helped to make the protein and fat in the formula more readily assimilable by the pups.

Postrelease weight loss: Tara's weight loss from 19 kg at the time of her last feeding to 15 kg on her return from sea 13 days later represents a 4 kg or 21% weight loss during the immediate postweaning period, which would



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FIG. 6 Tara at Millin Bay (26 October 1997).



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FIG. 7 Tara at Millin Bay (30 November 1997).

be expected even in wild pups (Muelbert and Bowen 1993). Weaned pups of approximately the same body size as Tara at 15 kg have often been seen at Minerstown in August, and there is no reason to believe that a weight loss to that level is a threat to survival, provided the pup has started to learn to feed.

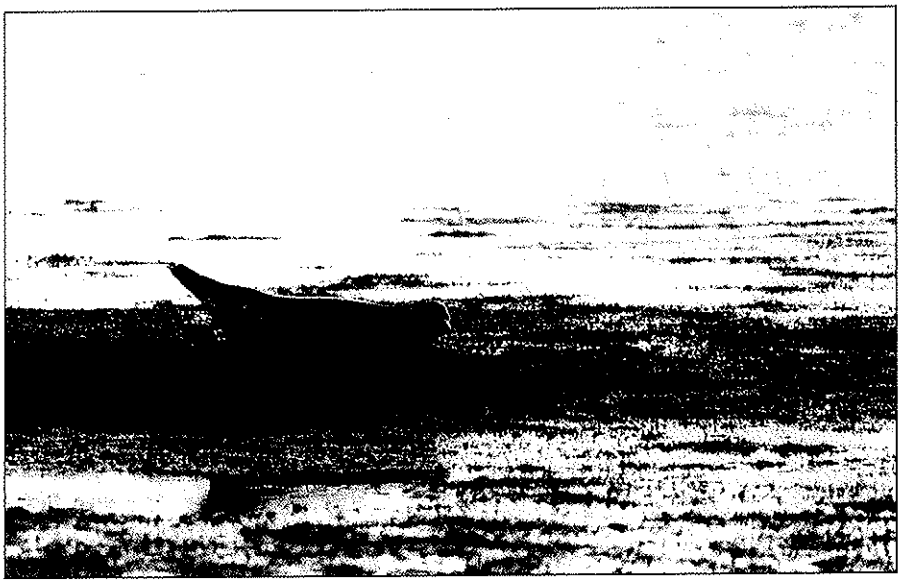
Diving behavior and foraging areas: Caolan achieved a maximum dive time of 100 s on his first day of release, while Tara did so on her second day. Typical foraging dives of harbor seals, including young in their first year, tend to be 2–3 min duration; such dives did not occur regularly until the pups had left the release site and established a foraging area. These areas for both pups were within the overall range found for five wild pups (pups 1, 2, 4, 5, and 6) during September and October 1995 (Fig. 4; Wilson and Corpe 1996) and one rehabilitated weaned pup (pup 9, Cecilia) tracked in 1996 (Fig. 4; Wilson et al. 1999). The pattern emerging from these studies in County Down is that in the late summer and autumn each pup selects a preferred foraging area within an area quite clearly delineated between Killard Point (just south of Strangford Lough) to the north and Carlingford Lough to the south (Fig. 4). This foraging area corresponds well to the known distribution of the spawning and nursery areas for the seal pups' prey species, including flatfish, gadoid species, and herring (Armstrong and Dickey-Collas 1997).

Tara's "homing" behavior: In her frequent return from foraging areas to the site of her release and initial stranding, Tara possibly resembled some of the pups tracked in the California study (Morgan et al. 1993), and also a pup released at one year from a site near Oban, Argyll, who continued to return to her release site long after she ceased to receive food there (Picken 1978).

Conclusions: This pilot rehabilitation project has demonstrated that two neonatal harbor seal pups stranding at 7.5–8 kg (a) gained 0.3 kg/d average on an entirely liquid formula and (b) not only survived following their release at 4–5 weeks of age, but remained in the local population and occupied similar swimming and foraging areas to wild pups weaned locally. These results raise questions concerning the necessity and possible counterproductivity of established rehabilitation practices, which often involve keeping pups in captivity for four months or more.

Acknowledgments

I am grateful to Heather Corpe of Aberdeen University for her discussion and support throughout this study; to Michael Watts and Natasha Melbourne of the Peninsula Veterinary Clinic for their veterinary support and assistance in attaching the radio-tags; to Laurie Gage of Marine World, California, who suggested adding cow's cream and lactase to the pups' milk formula; to James McDonald of Nutrizec for donating enzyme tablets for the milk formula; to Ian Robinson of the RSCPA wildlife hospital in Norfolk, Debbie Hoffmann at Pet-Ag, Illinois, and Paul Thompson of Aberdeen University for their advice; to Ken Waterson of the Basking Shark Project; to Delma Daly of Tara, Millin Bay, who found pup 10 (Tara); and to Terry Swinson, Grace Wilson, Fanni Marr, Janie Ferguson, Laura Ferguson, Sheila Campbell, Bridie McLaughlin, Tania Johnston, Brian Black, Mark Davis, and all neighbors and friends for their help and sup-



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Fig. 8. Tara at Millin Bay after her radio-tag had fallen off (1 February 1998).

port throughout the rehabilitation and tracking procedure. I am grateful to the Environment and Heritage Service for supplying the radio-tags and radio-tracking equipment. The study was carried out under EHS license no. TSA/7/97 to Susan Wilson.

Endnotes

[1]Manufactured by Milk Specialities Company, 261 Keyes Avenue, P.O. Box 396, Hampshire, IL 60140, U.S.A.

[2]Essential Enzyme, source Naturals Inc., and Power Enzymes, New Spirit Naturals, Inc., supplied by Nutrizec, P.O. Box 3102, Wokingham, Berks, RG41 3YW, U.K.

[3]ATS, Isanti, MN 55040, U.S.A.

[4]Telonics Telemetry, 932 E. Impala Avenue, Mesa, AZ 85204-6699, U.S.A.

[5]On 18 October she was found to have an open lesion on the left side of her head approximately 1 cm round, with a 3 cm long area of swelling below it. This may have been caused by scratching below the tag attachment area. She was coaxed up to the pen, where she was treated by a veterinary surgeon with an antibiotic injection and antibiotic topical spray. On subsequent visits the lesion was seen to be healing well and no further lesions occurred.

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To Contact the Author:
Susan C. Wilson
School of Biology and Biochemistry
The Queens University of Belfast
Correspondence address:
7 Millin Bay Road
Tara, Portaferry
County Down BT22 1QD
Northern Ireland, U.K.
suewilson@marinelife.demon.co.uk

Radiotelemetry Study of a Harbor Seal Pup Released After a Brief Postweaning Rehabilitation Period

by Susan C. Wilson, Heather M. Corpe, and Seamus Kennedy

ABSTRACT: A postweaning harbor seal pup was taken from a haul-out site at Minerstown in County Down, Northern Ireland, for rehabilitation, owing to her small size and emaciated appearance. She was fed a high-fat/high-protein liquid diet for three weeks and then fitted with a head-mounted VHF radio-transmitter and released, weighing 15.5 kg.

During the next six weeks, radiotracking found her diving off the County Down coast, moving within the range known to be used by wild weaned pups from Minerstown. Between four and six weeks after release she was sighted on three occasions at the Minerstown haul-out site in the company of other postweaning pups, and each time appeared to be in good health and approximately the same size as the other pups. Two weeks later, however, she stranded with a swollen shoulder and fore-flipper; despite veterinary treatment, she died three days later. Postmortem examination revealed a fracture of the left ulna and parasitic pneumonia. Observations during the week prior to her stranding suggest a gradual deterioration in her condition stemming from the trauma to her shoulder, which was most probably the result of collision with a boat.

KEY WORDS: Harbor Seal, Pup Rehabilitation, Postrelease, Behavior, Survival

This report describes the outcome of a quick rehabilitation procedure on an emaciated postweaning pup. The rehabilitation was intended to give the pup a nutritional boost, release her as quickly as possible, and then follow her progress and compare it with that of wild postweaning pups.

Initial Assessment and Rehabilitation Procedure

The pup (ID no. 9, Cecilia) was found on 13 August 1996 at Ringboy Point, Minerstown, County Down, Northern Ireland. She was one of 12 pups present at Ringboy Point that day. Cecilia had evidently mastered the skill of capturing and eating very tiny fish: her fecal sample contained 21 gadoid otoliths—8 whiting (*Merlangius*) and 13 pollack or saithe (*Pollachius sp.*), from fish estimated to be between 47 and 108 mm long (Harkonen 1986). Nevertheless, she was extremely small and appeared emaciated. Because her condition seemed life threatening, a decision was made to take her for rehabilitation (Fig. 1).

The pup did not appear to be suffering any injury or infection and therefore did not receive any medication. She was fed by stomach tube a liquidized formula based on Multimilk[1] with added homogenized herring fillets. She was given 350–450 ml four times daily for 10 days and then 650–700 ml three times daily for 10 days until her release. She visibly gained condition and weight (Fig. 2).

Release and Tracking

On the day of her release (2 September 1996) the pup was weighed (15.5 kg), measured (85 cm from nose to tip of tail) and fitted with a head-mounted VHF tag[2] glued with epoxy resin to the top of the head (Fedak, Anderson, and Curry 1983). She was also marked with a plastic, numbered roto-tag and a fluorescent dye mark applied to the fur of the back (see also Wilson and Corpe 1996). She was then released at high tide at Ringboy Point, Minerstown (Fig. 3).



BRIAN BLACK

FIG. 1 Pup 9 (Cecilia) at her initial rescue at Ringboy Point, Minerstown, 13 August 1996.

SUSAN C. WILSON, BSc, MSc, PhD, LLM
(see p. 5)

HEATHER M. CORPE, BSc, PhD
After earning her undergraduate degree in biological sciences at Portsmouth Polytechnic, Dr. Heather Corpe spent three years working in the seal rehabilitation facility at the Sea Life centre in Hunstanton, Norfolk, England. She then moved to the Scottish highlands to start her PhD research on the behavioral ecology of harbor seal pups at the University of Aberdeen. Since then she has worked on the Northern Ireland Environment & Heritage Service's harbor seal research project, and with Scottish Natural Heritage. She is currently the Moray Firth Special Area of Conservation project officer, coordinating the formation of a management scheme for the Moray Firth population of bottlenose dolphins.

SEAMUS KENNEDY, MVB, MRCVS, DipECVP, MRCPath
Dr. Seamus Kennedy earned his degree in veterinary medicine in 1979 and has worked as a veterinary pathologist for the past 19 years. His main current scientific interest is in viral diseases of animals, although he has previously worked on vitamin E, selenium, and cobalt deficiencies in cattle and sheep. He has carried out extensive investigations on morbillivirus infections in aquatic mammals and is currently studying circovirus and paramyxovirus infections in pigs and bovine viral diarrhea virus infection in cattle. He is author of more than 180 scientific publications.

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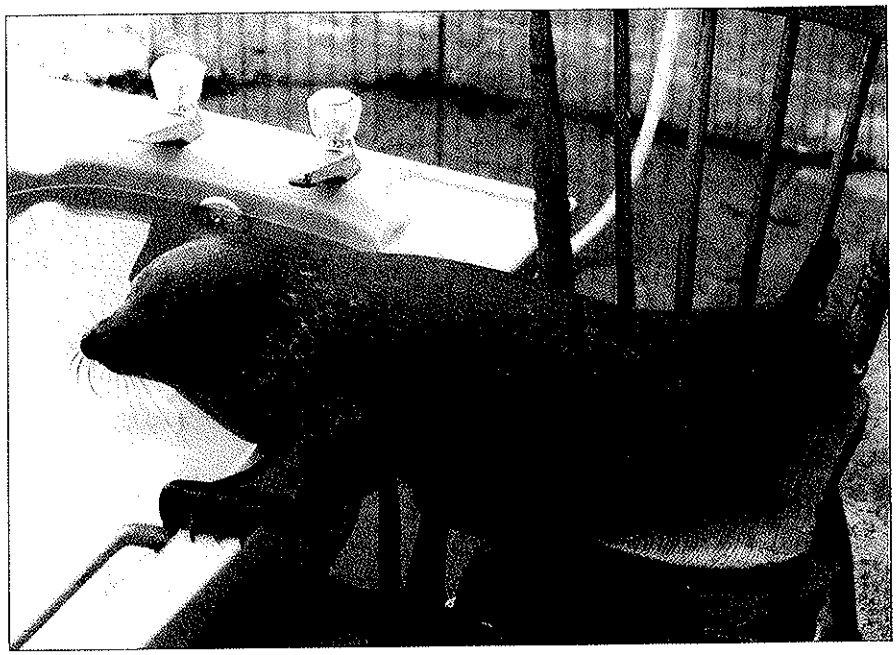

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FIG. 2 Cecilia in her rehabilitation pen, 17 days after her initial rescue.

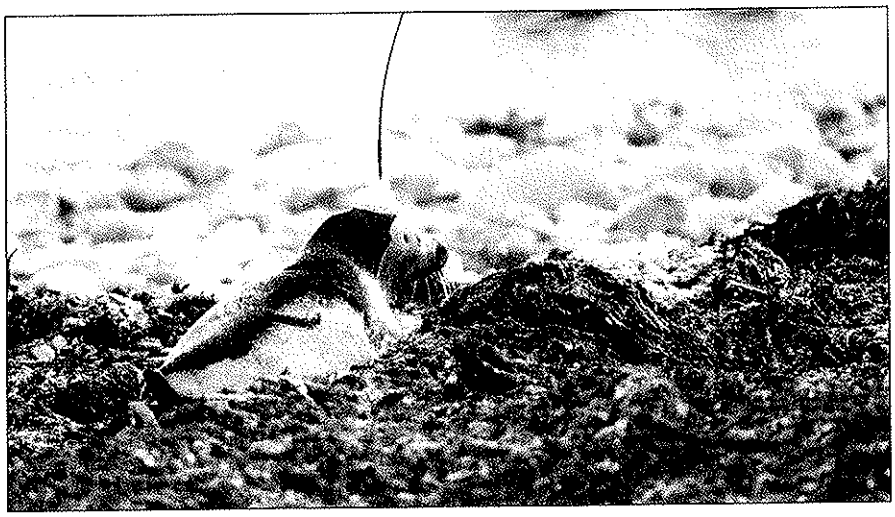
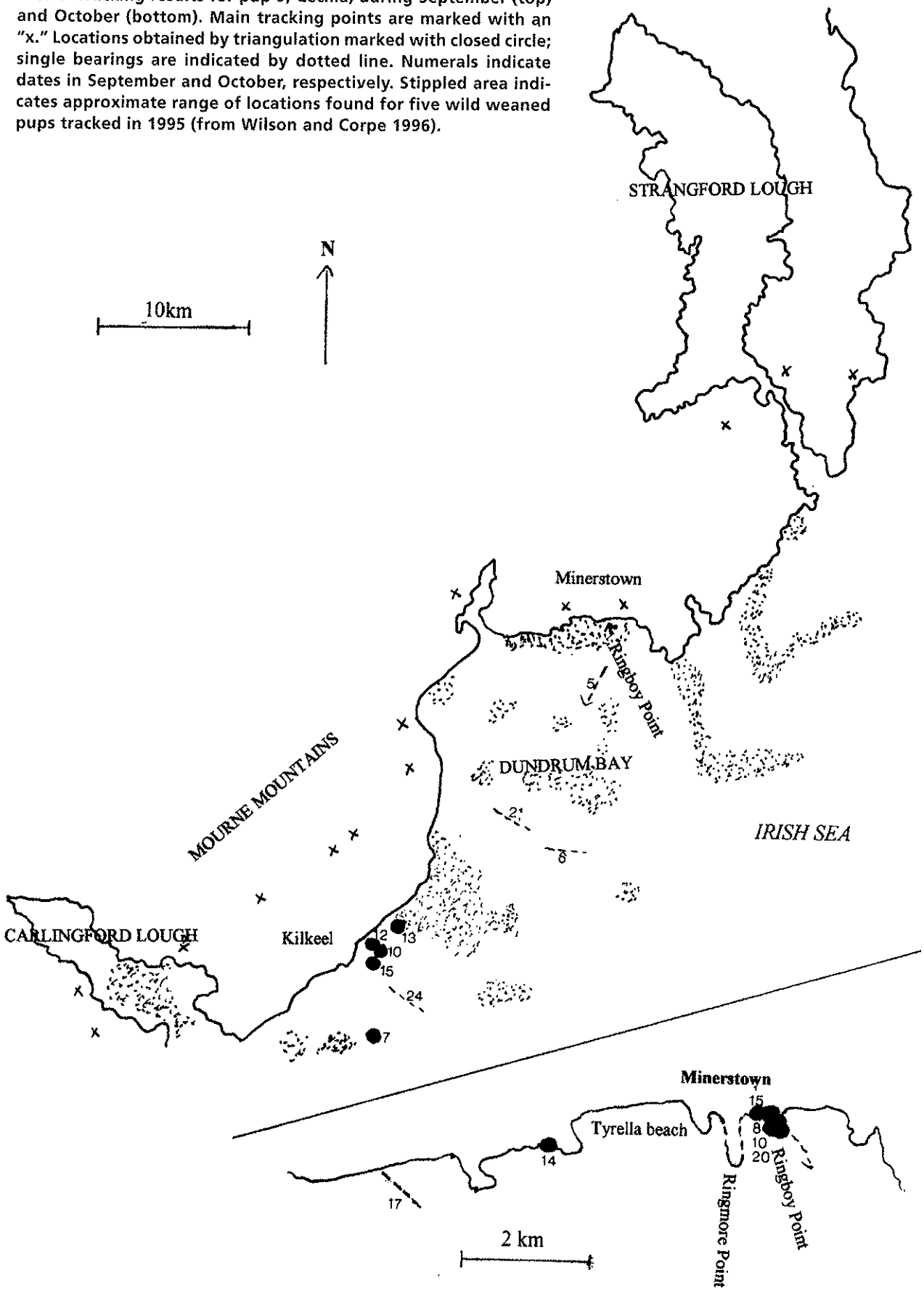

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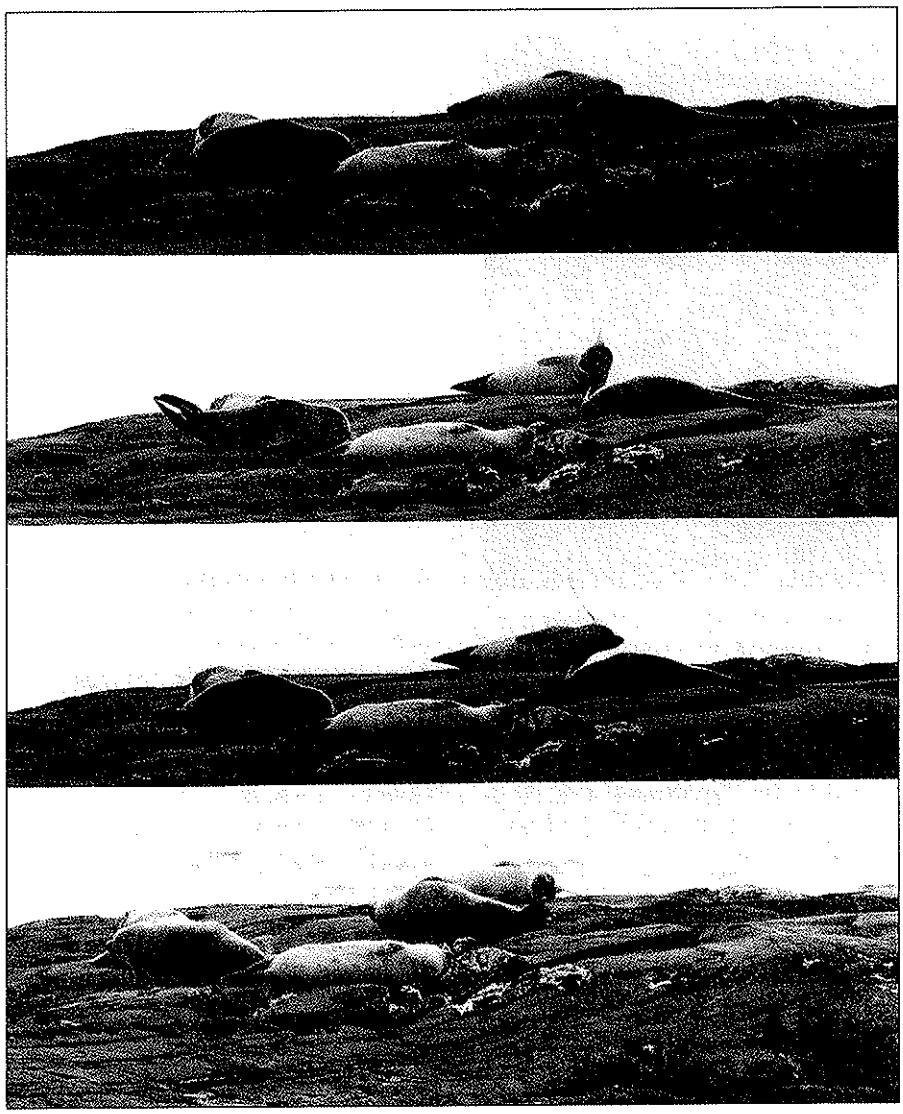
FIG. 3 Cecilia at her release at Ringboy Point, Minerstown, 2 September 1996, with head-mounted radio-tag and dye mark "C" on her back.

The pup was tracked using a TR2 VHF[3] receiver and Yagi aerial from vantage points along the nearby coast (Fig. 4; Wilson and Corpe 1996). Immediately following her release her dive times at Minerstown averaged 96 s (max. 148 s, n=16) and she was found to be heading south. She was tracked daily for five days following her release and two to four times a week thereafter. On 5 September she was detected in Dundrum Bay heading in a southwesterly direction; the following day she was detected off the Mourne coast, where she remained for the balance of the month. During this period she was always found to be diving, with dive times averaging 2 to 3 min (max. 199 s, n=18). No radio signal was obtained during tracking on 3, 4, 8, 17, 19, or 27 September.

The pup's behavior changed in October. On 1, 8, and 10 October she was seen hauled out at Ringboy Point, Minerstown, in the midst of other seals, including pups. Close-up photographs of Cecilia surrounded by four other pups

FIG. 4 Tracking results for pup 9, Cecilia, during September (top) and October (bottom). Main tracking points are marked with an "x." Locations obtained by triangulation marked with closed circle; single bearings are indicated by dotted line. Numerals indicate dates in September and October, respectively. Stippled area indicates approximate range of locations found for five wild weaned pups tracked in 1995 (from Wilson and Corpe 1996).





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FIG. 5 Cecilia (center, top) hauled out with four other pups at Ringboy Point, 10 October 1996. Note the similarity in size between Cecilia and the other pups and that she is lying, with no apparent discomfort, on her left flipper, which was subsequently injured.

taken on 10 October confirm her healthy appearance; her size was similar to that of the other pups (Fig. 5). No radio signal was obtained on 7, 13, and 22 October.

On 15 October the first signs of a problem became evident. On that day she was being chaperoned by a juvenile estimated to be between one and two years old. Cecilia seemed weak; she was unable to hold her position on the rock when waves washed lightly over her. On 20 October she appeared to have lost weight. She had hauled out alone and was lying on her right side. On 24 October she was found stranded at the high-tide mark at Minerstown. She was lying on her right side and her left shoulder appeared to be swollen (Fig. 6). Her breathing was shallow and rapid and she was coughing blood. She was taken back to the rehabilitation center, where she was treated for worms, given intensive antibiotic and anti-inflammatory therapy, and again fed a liquid diet. Unfortunately she showed little response and died three days later.

A postmortem examination[4] revealed that she weighed 12 kg and the distal region of the left ulna was completely fractured. The left flipper was filled with pus and the lung condition indicated severe parasitic pneumonia with intrabronchial hemorrhage and large numbers of worms present. *E. coli* and *Aeromonas spp.* were found in both lungs and pus was found in the flipper, suggesting septicaemia.

Discussion

The results from tracking Cecilia between 2 September and 10 October indicated that she was foraging in the area off the Mourne coast normally frequented by wild postweaning pups (Wilson and Corpe 1996) and her dive times were normal for a postweaning pup in waters up to 30 m (Corpe et al. 1995). Her healthy appearance and size compared with other pups at the Minerstown haul-out in early October confirmed the impression from tracking her in the water that her behavior was indeed normal. The photographs taken on 10 October show her lying without discomfort on her left shoulder.

Cecilia's apparent slight weakness on 15 October suggests she met with an accident between 10 and 15 October in which her ulna was fractured, presumably (since she had no other injuries) by a single massive blow. A fast-moving boat most likely caused the trauma. The fracture would likely have immediately prevented her from moving the flipper and from diving and foraging, resulting in weight loss over a period of at least 10 days. As the infection from the broken bone spread, pain in the region and general illness would obviously have worsened her situation. Lung worm infestation apparently occurs in virtually all harbor seals younger than one year (Claussen et al. 1991) without normally causing debilitation. However, a condition of shock following severe trauma could be sufficient to alter the normal physiological balance between the pup and the parasite, resulting in the worms' destruction of the lung tissue.

This pup's tragic accidental death should not obscure the main result of this exercise, which is that an emaci-



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FIG. 6 Cecilia stranded on the high tide mark on the beach near Ringboy Point, 24 October 1996. The swollen left flipper was due to a fracture of the left ulna.

ated, postweaning pup, given only a short-term nutritional boost rather than a long-term rehabilitation resulted in an apparently successful return to the wild. Four weeks after the pup's release at 15.5 kg, her appearance and behavior were indistinguishable from that of other pups. This implies that a postweaning pup taken for rehabilitation may not need to be kept in captivity, as is usual practice, for many weeks until it weighs 25–30 kg, particularly if examination of the feces at the time of stranding indicates the pup has already begun to catch fish. Cecilia's presumed collision with a boat unfortunately appears to be a common occurrence in this area, since seals of all ages at Minerstown are often seen with flesh wounds or scars probably caused by boat propellers.

Acknowledgments

We would like to thank Ian Robinson for his advice and discussion of rehabilitation procedures, and Mike Watts and Natasha Melbourne for veterinary treatment of the pup. We would also like to thank Terry Swinson, Grace Wilson, and Brian Black for their assistance with the pup during rescue and rehabilitation. The tagging of the pup was carried out under EHS license TSA/L/005/96 to Susan Wilson and the study was funded by the Environment & Heritage Service of the DOE (Northern Ireland).

Endnotes

[1]Now manufactured and marketed as Zoologic Milk Matrix 30/55 by Milk Specialities Company, 261 Keyes Avenue, PO Box 396, Hampshire, IL 60140, U.S.A.

[2]ATS, Box 398, Isanti, MN 55040, U.S.A.

[3]Telonics Telemetry, 932 E. Impala Avenue, Mesa, AZ 85204-6699, U.S.A.

[4]The postmortem was conducted by Dr. Seamus Kennedy at the Veterinary Science Division of the Department of Agriculture for Northern Ireland (DANI).

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To Contact the Authors:

Susan C. Wilson
School of Biology and Biochemistry,
The Queens University of Belfast
Correspondence address:
7 Millin Bay Road
Tara, Portaferry
County Down, BT22 1QD
Northern Ireland
suewilson@marinelife.demon.co.uk

Heather Corpe
c/o the Moray Firth Partnership
27 Ardconnell Terrace
Inverness, IV2 3AE
Scotland, U.K.
heather.corpe@sepa.org.uk

Seamus Kennedy
Veterinary Sciences Division
Department of Agriculture for
Northern Ireland
Stoney Road, Stormont
Belfast BT9 7BL,
Northern Ireland, U.K.
Seamus.Kennedy@dani.gov.uk

Radiotelemetry Study of Four Rehabilitated Harbor Seal Pups Following Their Release in County Down, Northern Ireland

by Susan C. Wilson, Tania Johnston, and Heather M. Corpe

ABSTRACT: Four harbor seal pups stranded in County Down, Northern Ireland, in 1995 and 1998 were rehabilitated in a public aquarium facility. They were fed on liquidized and solid herring diet and gained approximately 0.05 kg/d for about the first 10 weeks and subsequently about 0.3 kg/d until their release at about four months of age.

The seal pups' progress after their release was followed by radiotelemetry for three months. Two pups survived this period, one died of unknown causes near the release site about a week after release, and one disappeared shortly after release and was not relocated. One of the surviving pups emigrated from the area within four days of her release and took up residence in a shallow commercial harbor for two months before eventually emigrating further south to Dublin Bay. The other returned only infrequently to the County Down coast, but was seen amongst a local haul-out group after 12 weeks, and was apparently healthy and well grown.

KEY WORDS: Harbor Seal, Pup Rehabilitation, Postrelease, Behavior, Survival

This study was designed to follow by VHF radiotelemetry the progress of four rehabilitated harbor seal pups after their release. The pups had been rehabilitated over an approximately four-month period in the context of a public display in County Down, Northern Ireland. The study's ultimate aim is to accumulate data from a sufficient number of pups rehabilitated in this context in order to assess their chances of survival and compare their postweaning movements and survival with wild postweaning pups from this area (Wilson and Corpe 1996.)

Pup Feeding and Weight Gain During Rehabilitation

The pups had all stranded along the County Down coast during or just after the pupping season (Table 1, p. 18). Three were neonatal; one (pup 13, Po) was probably postweaning.

All four pups were rehabilitated at Exploris public aquarium, Portaferry, County Down, Northern Ireland. The pups were initially maintained in an outdoor shed and subsequently transferred to an outdoor saltwater pool (approximately 0.5 m deep and 25 m square). All pups were given worming medication on arrival and prophylactic antibiotics (Synulox and Cephalexin) for the first seven to 10 days.

Pups 7 (Snap), 8 (Pop), and 12 (Laa-laa) were initially fed liquidized herring (fillets from two fish made up in Lectade veterinary oral rehydration fluid to 600 ml at each feed, or half that amount for the first two to three days), either by nursing from a baby's bottle (Snap and Pop) or by domestic calf feeding tube (Laa-laa). The pups were initially fed four times a day between 9 am and midnight. After seven to 10 days, the pups were fed herring fillets and eventually whole dead herring, with most pups handfeeding within two weeks of arrival. Pup 13 (Po) was fed two whole herring on the first day and six fish per day for the next three days, but was also given 300 ml Lectade at each feed. The amount of fish in each feed was gradually increased to about 10 fish per feed while the frequency of feeding was correspondingly reduced to twice a day, so that the pups eventually received about 2 kg of herring per day until their release. All pups received a daily multivitamin tablet (Aquavits). The records for pups 12 and 13 indicate that the weight gain on this diet remained approximately 0.05 kg/d on average for about the first 10 weeks, resulting in a total gain of about 4 kg over this period, but subsequently increased much more rapidly (approximately 0.3 kg/d average) over the next six weeks (Fig. 1). Before their release pups 7 and 8 were given live rockling, butterfish, wrasse, and crabs, most of which they ate. However, pups 12 and 13 were not given live fish prior to release.

Only four Exploris staff members handled the seals. When the pups were moved permanently to the pond, staff contact was eliminated, although the public could view the pups (and vice versa) along one side of the pond.[1]

Fitting of the Radio-Tags and Release

The pups were released at about four months of age. Each pup was fitted with a VHF radio-tag[2] immediately prior to release. The pups were strapped to a re-

SUSAN C. WILSON, BSc, MSc, PhD, LLM
(see p. 5)

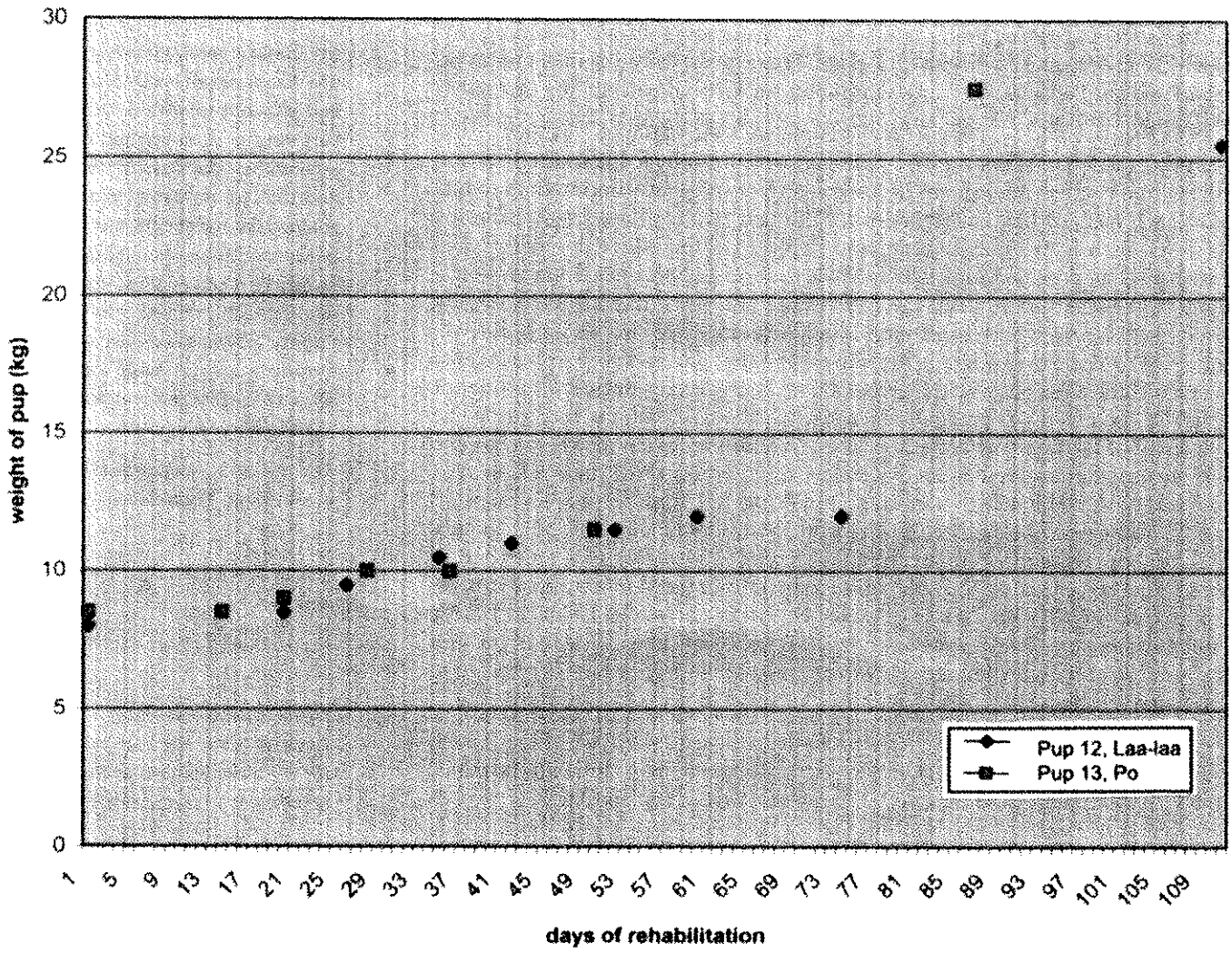
HEATHER M. CORPE, BSc, PhD
(see p. 12)

TANIA JOHNSTON, BSc
Tania Johnston has been responsible for the development of the seal rehabilitation program at the Northern Ireland Aquarium (now Exploris) at Portaferry since it first opened in 1989. During this time she has cared
(Author biography continued on p. 19.)

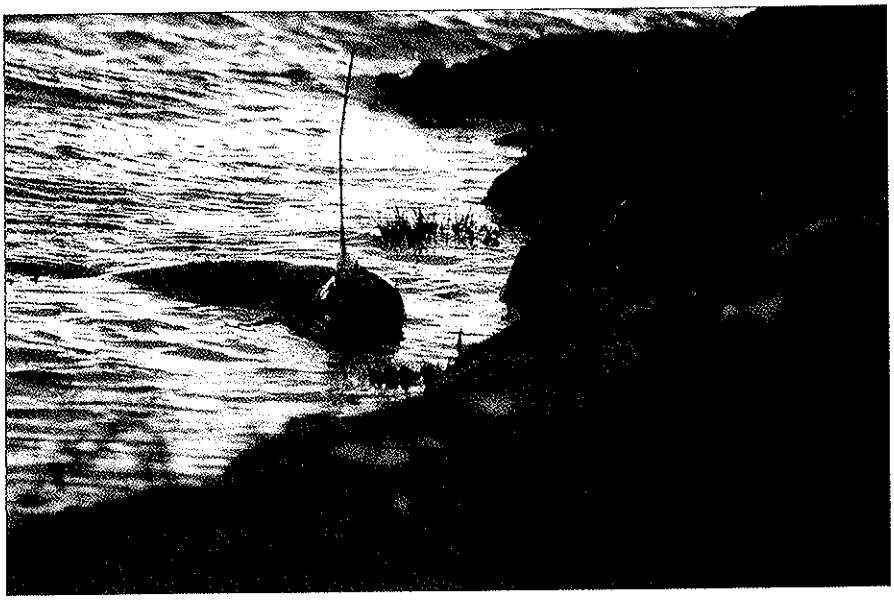
TABLE 1 INDIVIDUAL PUP DATA

Name	Snap	Pop	Laa-laa	Po
ID No.	7	8	12	13
Gender	male	female	female	female
RESCUE:				
Date	22JUN95	14JUL95	14JUL98	8AUG98
Weight	6.6 kg	7.5 kg	7.5 kg	8.5 kg
Location	Strangford Lough	Dundrum Bay	Dundrum Bay	Dundrum Bay
Estimated Age	4–7 days	4–7 days	4–7 days	30 days
RELEASE:				
Date	27OCT95	27OCT95	5NOV98	5NOV98
Weight	28.5 kg	30 kg	25.5 kg	27.5 kg

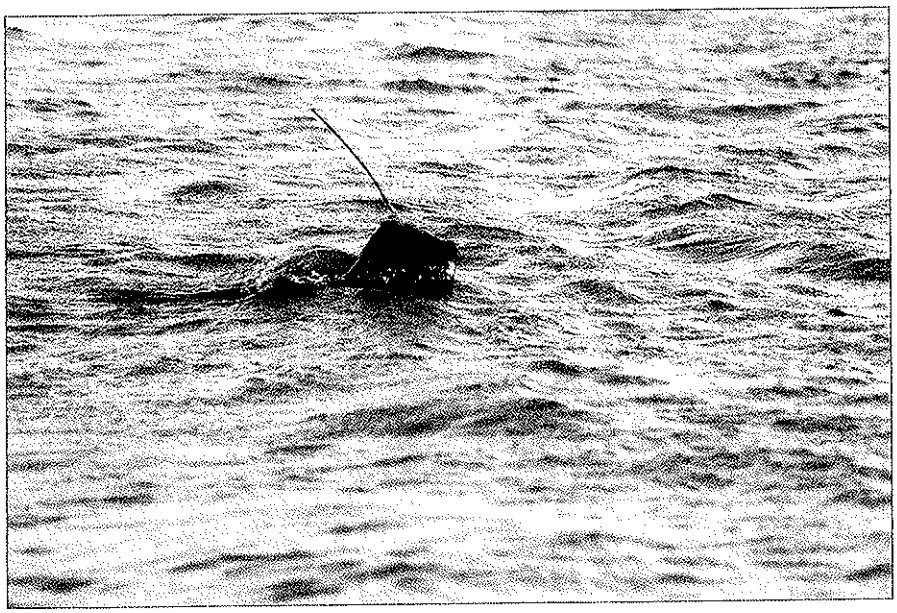
FIG. 1 (BELOW) Weight gain by pups 12 (Laa-laa) and 13 (Po) during rehabilitation at Exploris Aquarium, July–November 1998.



straining board while the radio-tags were attached to the top of their heads with Araldite Rapide epoxy resin (Fedak, Anderson, and Curry 1983); a fluorescent dye mark was applied to the fur of the back (Thompson 1989). Roto-tags were inserted into the web of the right hind flipper of pups 7 and 8. (The tags bore a unique number and a request to inform London Zoo should the seal be found stranded or dead.) Pups 7 and 8 were released at Minerstown, Dundrum Bay, a known gathering point for postweaning harbor seal pups (Wilson and Corpe 1996); pups 12 and 13 were released at Granagh Bay, in the Strangford Lough Narrows (Figs. 2 and 3). An untagged pup (named Tinky Winky) was released with pups 12 and 13.



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FIG. 2 Pups 12 (Laa-laa; top) and 13 (Po; bottom) at their release at Granagh Bay, 5 November 1998.

Radio-Tracking the Pups After Release (Fig. 3)

The pups were subsequently tracked once or twice a week, weather permitting, for about 13 weeks, using a TR2[3] receiver and Yagi aerial. Tracking was carried out from previously established tracking points between Strangford Lough and Carlingford Lough (Wilson and Corpe 1996); tracking attempts were also made from the top of Scrabo Tower (north Strangford Lough), the Carlingford mountains overlooking Dundalk Bay; Dundalk Harbor and Castletown River; Clogherhead (south of Dundalk Bay); and Howth Head overlooking Dublin Bay. Each pup behaved differently upon release, as summarized below.

Pup 7 (Snap)

Immediately after release on 27 October 1995, Snap swam, without diving, close inshore, slightly south of the release point and in the company of pup 8 (Pop). For the next two days he remained close inshore about 7 km west of the release site, making dives averaging less than 1 min (avg. 33 s, max. 63 s, n=26 on 28 October 1995; avg. 44 s, max. 72 s, n=23 on 29 October 1995). For the following two days he was located 5–6 km offshore in water of >20 m, but his dive times remained short (avg. 29 s, max. 68 s, n=14 on 30 October 1995). On 1 November 1995 he was located about 4 km offshore of the release site, but from 2 November a continuous signal was received from the vicinity of Tyrella beach, and it is believed he may have died about this time. A member of the public found his body (with the head and tag missing) in a deteriorated condition on 12 November about 0.5 km south of the release site.

Pup 8 (Pop)

Immediately after release on 27 October 1995, Pop swam close inshore,

(continued from p. 17)

for more than 60 harbor and grey seal pups, while completing her degree in biological sciences at the Open University. She has had a major involvement in the new, state-of-the-art seal sanctuary, which opened at Exploris in December 1999; this is the only public facility in Northern Ireland involved in the rehabilitation of seal pups.

J. Wildlife Rehab. 22(3): 17–23

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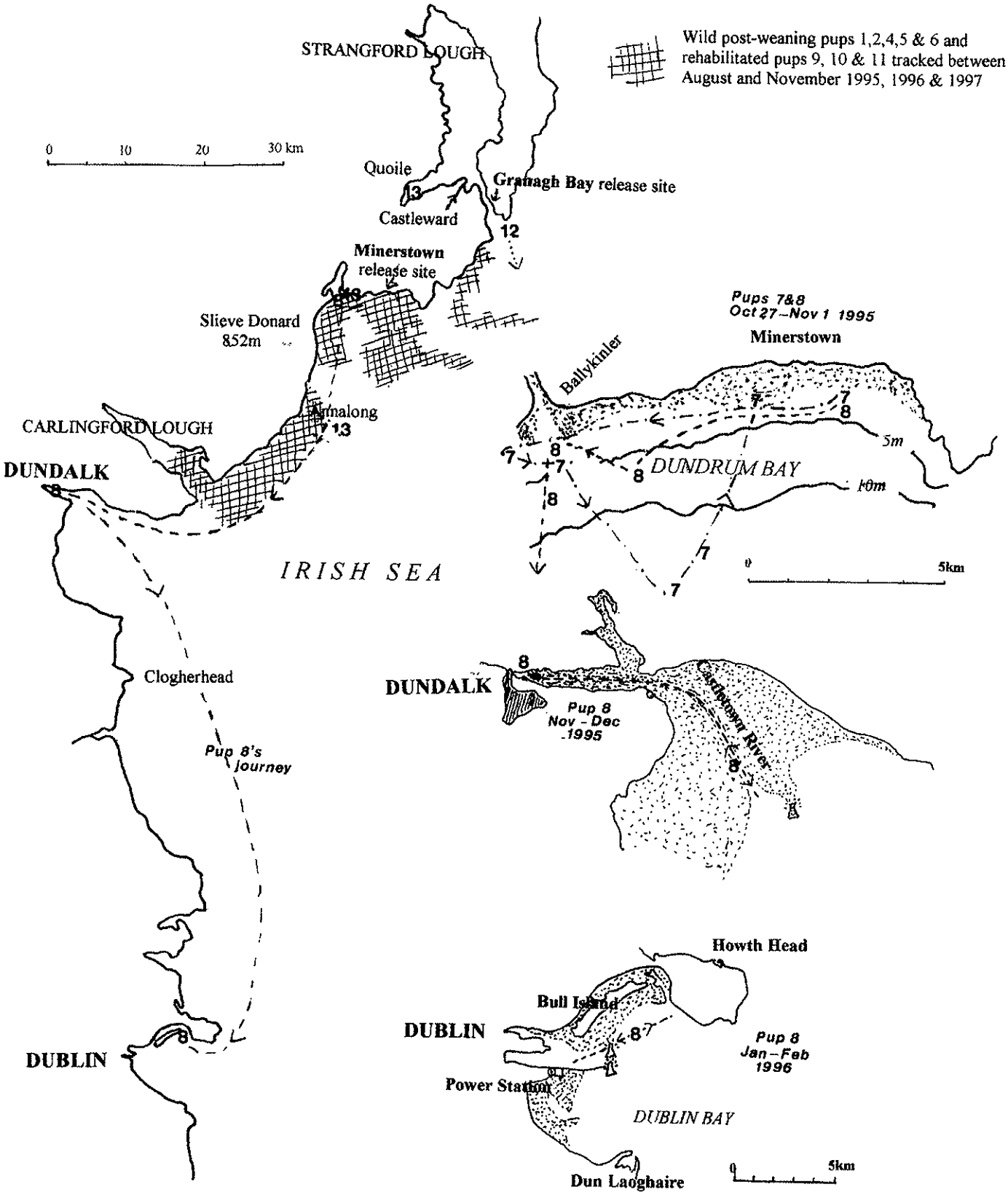
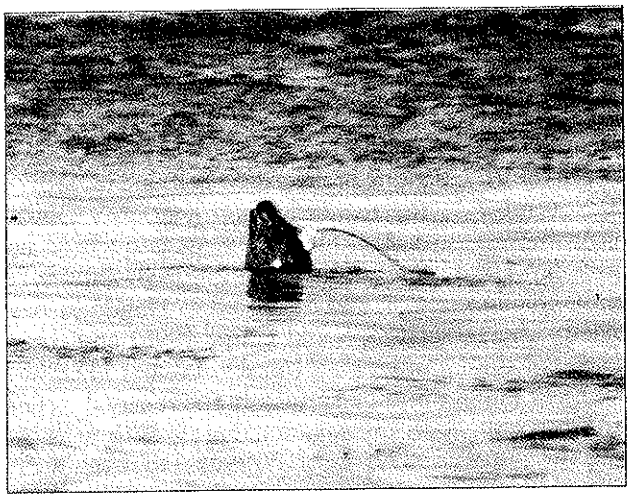


FIG. 3 Map of the east coast of Ireland between Strangford Lough and Dublin, showing the release sites and postrelease tracking results from pups 7, 8, 12, and 13. The approximate locations of the pups, determined either visually or by tracking, are indicated by the pup ID numbers.

slightly south of the Ringboy Point release site, in the company of pup 7 (Snap). During the first hour after release her mean dive time was 32 s (max. 60 s; n=13) in water <5 m depth. For the following three days Pop remained in Dundrum Bay, between 1 and 2.5 km offshore, in waters 5–20 m deep. Her mean dive times on these three days were 82 s (n=13), 41 s (n=27), and 81 s (n=12), respectively, with a maximum of 115 s. For the next two weeks her tracking signal was not picked up along the County Down coast.

On 18 November and apparently also about two weeks previously, however, Pop was sighted in Dundalk Harbor (C. McCarthy, pers. comm.). Until 26 December 1995 she was then seen almost daily in the harbor, apparently traveling downriver on the outgoing tide and returning to the harbor on the flooding tide. Her mean dive time in the lower river on 21 November was 111 s (max. 145 s, n=17). Although she did not approach people in the harbor, neither did she show fear of their presence. The water in the harbor was generally <5 m deep. Pop's mean dive times in the harbor on 23 November, 8 December, and 20 December were 63 s (n=60), 56 s (n=24) and 97 s (n=24), respectively, with a maximum of 136 s.

On 21 November she was seen to catch and eat two flounder in the harbor, one of which was so large that she spent several minutes at the surface, near the harbor quayside, eating it (C. McCarthy, pers. comm.). On 23 November she was observed surfacing while swallowing (Fig. 4) five times during a 2.5 hr period, but only one small white fish was actually seen by the observer. On 20 December she was observed to catch two eels (Fig. 4) in the upper harbor during a 1 hr period. She was observed in the upper river on 28 November and 4 December, where her dive times averaged 68 s (n=17) and 81 s (n=19), respectively. She was last seen in the Dundalk area between 26 and 31 December (C. McCarthy and P. McEnaney, pers. comm.). Although up to about 15 harbor seals haul out at the mouth of Castletown River, Pop was not seen to join them, or indeed to haul out at all, during her sojourn in Dundalk.



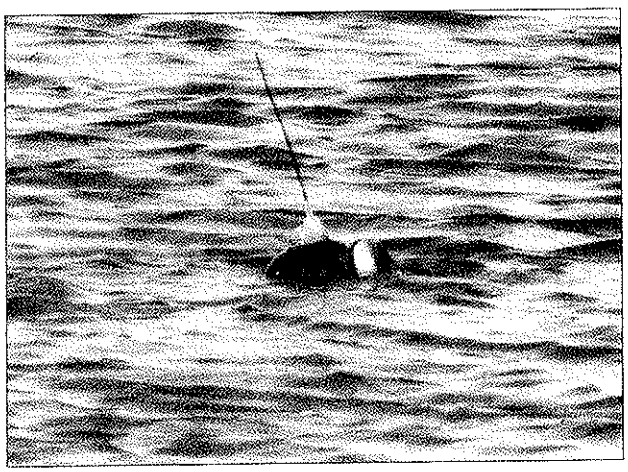


FIG. 4 Pup 8 (Pop) in Dundalk Harbor.

(Top) 23 November 1995: Swallowing a fish.

(Bottom) 20 December 1995: Struggling with an eel (wrapped over her nose).

On 15 and 16 January 1996, Pop was seen (by a woman walking her dog) hauled out alone on Bull Island, Dublin Bay, several hundred meters away from a small harbor seal haul-out (nine seals on 17 January). Pop did not seem alarmed by the close human approach and appeared plump and in good health (H. Keogh, pers. comm.). She was located in the water close to Bull Island on 17 January and in Dublin Bay between Howth Head and Dublin city on 21 and 29 January. The water depth in the bay varies up to about 28 m in the shipping channel. Her mean dive times were 136 s (n=22) and 125 s (n=26), with a maximum of 164 s.

Pup 12 (Laa-laa)

Immediately after her release on 5 November 1998 Laa-Laa swam and dived in Granagh Bay. Her mean dive time was 58 s (max. 125 s, n=8). On the following day the radio signal indicated that she was heading out of the Lough in a southwesterly direction. No further signal from Laa-laa was obtained on 19 tracking attempts between 14 November 1998 and February 13 1999, including one from the summit of Slieve Donard on 29 November; one from Clogherhead on 15 December; and one from Howth Head overlooking Dublin Bay on 19 January 1999. It was therefore presumed that Laa-laa had left the study area or died, or that her tag had stopped transmitting.

Pup 13 (Po)

Immediately following her release (together with pup 12 and the unmarked Tinky Winky) at Granagh Bay, Strangford

Lough, on 5 November 1998, Po swam about in the bay with dive times averaging 25 s (max. 40 s, n=10). The following day she was detected near the mouth of the Lough. A dive time of 105 s was recorded from her in the vicinity of Castleward on 10 November (T. Johnston, pers. comm.); she was then seen on four consecutive days (10 through 13 November) in the Quoile, Strangford Lough, beside a jetty where men were working on boats. For the first two days another untagged pup (probably Tinky Winky) was seen with Po, both pups approaching the jetty closely (J. Carroll and J. Montgomery, pers. comm.).

No further signal was received from Po on seven tracking days between 14 November and 13 December, including one attempt from the summit of Slieve Donard on 29 November; on 15 December a diving signal was received in the vicinity of Annalong. Her diving pattern appeared to be normal (3–4 min interval between signals). No further tracking success was obtained until 21 January 1999, when a haul-out (i.e., continuous) signal was received from Ballykinler. A haul-out signal was again received from Ballykinler on 22 January, and on this day the pup was viewed through a telescope and found in the midst of the haul-out group there, moving along the beach with the other seals in response to the tide. She appeared well grown and healthy and her tag was still well attached. The following day she had left Ballykinler and no further signal was received from her for the last three weeks of the study.

Discussion

The only conclusion that may be drawn so far from the tracking of these four pups is that the survival and normality of behavior of such rehabilitated pups following their release may not be taken for granted. Only two of the four pups are known to have survived more than a week after release[4] and only one of these pups integrated into a haul-out group of the local population.

A normal dive time for a pup foraging offshore is usually 2–3 min (Corpe et al. 1995). Pup 7, who died after a week, did not achieve this, but the two pups who were known to have survived both had normal dive times when they were located offshore. None of the pups was found to be diving regularly in the County Down coastal foraging areas frequented by five wild postweaning pups (pups 1, 2, 4, 5, and 6) tagged in Dundrum Bay (Wilson and Corpe 1996) and three other pups (pups 9, 10, and 11) rehabilitated privately and released earlier in the summer (Fig. 3; Wilson et al. 1999; Wilson 1999). However, a direct comparison of the four Exploris pups with the movements of pups 1 through 6 and 9 through 11 is not appropriate, since the latter were tracked earlier in the season, between late July and early November. It is probable that Pup 13 (Po) may have been traveling to foraging areas at substantial distances from the County Down coast and it is entirely possible that many County Down harbor seals travel well away from the County Down coast during the winter months and that her behavior was normal. It is possible that pups taken into rehabilitation at a postweaning stage have already acquired some social and environmental orientation that facilitates their adjustment after release to the prevailing behavioral rhythm of the local population.

The only conclusion that may be drawn so far from the tracking of these four pups is that the survival and normality of behavior of such rehabilitated pups following their release may not be taken for granted.

The emigration of pup 8 (Pop) from the County Down population is consistent with the behavior of a minority of postweaning pups in a wild population; up to 20 percent of tagged pups in an Orkney population were estimated to have emigrated from their natal area (Thompson et al. 1994) and one (pup 4) of the five wild pups radio-tagged in Dundrum Bay may have emigrated about six weeks after weaning (Wilson and Corpe 1996). Although her southerly emigration, first to Dundalk Bay and eventually to Dublin Bay, could not therefore be considered abnormal, her two-month residence and foraging in Dundalk harbor *were* abnormal; wild harbor seal pups typically forage offshore, in the deeper (20–40 m) waters of the coastal shelf, and do not normally frequent artificial harbors. However the shallow water of locations like Dundalk harbor with its abundant fish fauna, may be attractive to a pup who is habituated to human presence (but not yet orientated within their environment), is inexperienced in foraging skills, and is unprepared for the physical demands of deep diving.

The pups' growth rate on first the liquid and then the solid herring diet was extremely slow, only 0.05 kg/d for the first 10 weeks or so. This contrasts with an estimated 0.6 kg/d growth rate in the wild (Bonner 1989) and 0.1–0.3 kg/d for pups in rehabilitation on various diet recipes based on high-fat milk formula (Ticheler et al. 1999; Wilson et al. 1999; Wilson 1999; I. Robinson, pers. comm.). It would therefore be possible to feed the pups a higher-fat diet, enabling them to grow more rapidly and be released much earlier if future results on pups retained for four months should continue to cast doubt on postrelease viability and normality of behavior. Studies on three pups fed a higher-fat diet and released after only three to five weeks (Wilson et al. 1999; Wilson 1999) are so far encouraging, but successful

results with more pups are needed before any conclusions can be drawn.

Acknowledgments

The authors are grateful to Caroline Nolan, Howard Scott, Keith Todd, Julian Whitehead, Judith Hassard, and colleagues at Exploris for permitting, and assisting in, the tagging of the pups.

We would also like to thank Mr. R. Fitzpatrick of Ardglass for reporting his finding of Snap's body. In Dundalk, we are indebted to Charlie McCarthy from Dundalk Harbor for reporting Pop's presence there and giving help and encouragement in tracking her in the Dundalk area, and also to Pat Gaskin of Belurgan Point for taking us downriver by boat, to Captain Gray of the harbor, and to all at the harbor who watched out for Pop during her sojourn there. In Dublin we are indebted to Hazel Keogh for reporting Pop's presence to us, to Pat Corrigan of the Bull Island Nature Reserve, and to Brendan Price of the Irish Seal Sanctuary. We would also like to thank Mark Davis of EHS for his support and Judith Montgomery and Gregor Watson, who listened for Laa-laa and Po from the summit of Slieve Donard.

EHS provided the radio-tags and tracking equipment, and funded the tracking of pups 7 and 8. The tracking of pups 12 and 13 was carried out on a voluntary basis. The tagging of pups 7 and 8 was carried out under an EHS license to Heather Corpe; the tagging of pups 12 and 13 was carried out under EHS license TSA/9/980 to Susan Wilson.

Endnotes

[1]The new seal sanctuary at Exploris, which opened in December 1999, has been designed in such a way as to minimize disturbance to the seal pups while allowing limited public viewing.

[2]ATS, Box 398, Isanti, MN 55040, U.S.A.

[3]Telonics Telemetry, 932 E. Impala Avenue, Mesa, AZ 85204-6699, U.S A.

[4]Transmitter failure cannot be ruled out as a possible explanation for the loss of contact with pup 12 a few days after release.

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To Contact the Authors

Susan C. Wilson
School of Biology and Biochemistry
Queens University of Belfast
Correspondence address:
7 Millin Bay Road
Tara, Portaferry
County Down BT22 1QD
Northern Ireland, U.K.
suewilson@marinelife.demon.co.uk

Tania Johnston
Exploris
The Ropewalk
Castle Street
Portaferry
County Down, BT22 1NZ
Northern Ireland, U.K.

Heather M. Corpe
c/o the Moray Firth Partnership
27 Ardconnell Terrace
Inverness, IV2 3AE
Scotland, U.K.
heather.corpe@sepa.org.uk

POSTSCRIPT

Conclusions Relating to Harbor Seal Pup Rehabilitation from the Case Studies

by Susan C. Wilson

At this stage of so few case studies, conclusions can only be in the form of strengthened or weakened hypotheses.

Some information pertinent to question 1, regarding the postrelease behavior patterns and survival of pups released at four months of age, was gained from the studies of the four pups released from the Exploris facility. The outcome in all four cases was different, leading only to the conclusion that successful adjustment to the wild cannot be taken for granted following this rehabilitation time. Although the pup who stranded postweaning did behave apparently normally within the local population after release, similar success was unable to be confirmed in the cases of three pups taken into rehabilitation shortly after birth.

Question 2 on whether it is possible to develop a high-fat, liquid formula so that the pup growth rate in rehabilitation may approximate that in the wild, was answered by pups 10 and 11 with some optimism. The high-fat formula with digestive enzymes fed to these pups did indeed enable them to grow only slightly more slowly than their wild counterparts. Their growth rate enabled them to be released within one to two weeks of the weaning period of the wild pups. However, the most critical features of the feeding—whether the fat content, enzymes, volume of frequency of feed—were not established and further improvements to the formula may be possible.

Question 3—Can pups, stranded at the nursing stage and released at four to five weeks of age, survive?—was answered with a resounding "Yes" by pups 10 and 11. After an initial week in shallow water in the vicinity of their release site, these two pups dispersed to local foraging areas in the same areas as their wild counterparts. The evident attachment of one of the pups (pup 10, Tara) to her caregiver and release site did not prevent her developing normal foraging behavior and eventual social integration, and therefore appeared not to be maladaptive.

Question 4—Can pups rehabilitated in the postweaning period be successfully returned to the wild after only brief veterinary treatment or nutritional boost?—was answered in the affirmative by pup 9, despite her subsequent untimely death due to accident trauma. However, pup 13, stranded as a postweaning pup and retained in the aquarium until about four months of age, also survived and integrated socially after her release. It is possible that pups who have had a natural nursing period in the wild and perhaps some wild postweaning experience before stranding have a postrelease advantage over pups who have experienced only the rehabilitation environment since stranding shortly after birth.

Thoughts for Discussion

Use of such a high-fat liquid formula should eliminate the necessity of training young pups taken into rehabilitation at an estimated age of six to seven weeks or younger to eat hand-fed dead fish. This practice, though nearly universal in seal rehabilitation facilities, is clearly unnatural and probably maladaptive. Wild seal pups are not fed solid food by their mothers after weaning and probably never consume prey they have not themselves caught live. Rehabilitated pups at Exploris fed on dead fish seem to gain weight so slowly that there would be no prospect of their release during the first 10 weeks of rehabilitation (see the weight gain for pups 12 and 13). Furthermore, the pups will, at best, have to unlearn their learned response to dead fish while acquiring appropriate predatory skills. At worst they may try to put into effect their response to dead fish by following fishing boats, as apparently was the case of the pup reared by Picken (1978), or by raiding fishing nets, with potentially fatal outcome (I. Robinson, pers. comm.; Morgan et al. 1993). Although many rehabilitation facilities do introduce pups to live prey before their release, such experiences, although undoubtedly helpful to some degree (as perhaps in the case of pup 8, Pop), would be unable to re-create the realistic circumstances of fishing in deep water for small benthic prey in the natural environment.

There is most probably a problem of maladaptive positive buoyancy in pups released after three to four-plus months of rehabilitation, owing to inevitable excessive blubber accumulation coupled with inadequate muscle development. This could result in difficulty for the pup in accomplishing effective foraging dives at normal depths of up to 30 m. The diving times of pup 7 of this study were abnormally short (and therefore probably shallow); pup 8 successfully circumvented the problem by taking up residence for two months in a commercial harbor where she needed only to dive a few feet to catch her prey. Rehabilitator intuition to the effect that the heavier the pups are at their release, the better their chances of survival, may therefore be a misapprehension. The finding by Corpe et al. (1995) that bigger pups in the wild are better divers is unlikely to be directly relevant to rehabilitated pups, whose balance between blubber accumulation and muscle development will probably be abnormal.

Pup 10's weight drop from 19 kg to 15 kg over 13 days (at six to eight weeks of age) following her final formula feed represented a 21% weight loss, which is apparently normal (Muelbert and Bowen 1993). Her diving behavior from that time in a normal foraging area and subsequent rapid weight gain suggested that she (in common with 70% of the pups studied by Muelbert and Bowen [1993]) had begun to feed effectively within two weeks of weaning. However, to allow for rehabilitated pups being amongst the bottom 30% of slower-learning pups, it might be wise to retain a 18–19 kg pup for an additional week on the high-fat diet, to be released at 20–21 kg and thus allow a wider safety margin for "slow learners." A longer period than this might be counterproductive, since the pups would merely acquire the impediment of surplus blubber while missing the important postweaning developmental stage of inshore orientation and catching of diminutive prey.

Finally, it should be noted that some earlier follow-up studies of harbor seals released from rehabilitation or longer-term holding in captive facilities have found poor survival or abnormal behavior (Picken 1978; Harvey et. al. 1983, Harvey 1987). However, a California radio-tagging study of rehabilitated pups indicated known (i.e., minimum) survival of 44% at 100 days (Morgan et al. 1993), and participation in local haul-outs by at least some pups. In contrast, Tougaard (1996) emphasizes that rehabilitation environments are totally unnatural and also claims that radio-tagging research in Denmark (details and sources not given) has shown that rehabilitated pups do not behave normally when compared to wild pups. Stranded harbor seal pups in Denmark are now euthanized, partly as a precautionary measure against the hypothetical spread of pathogens by rehabilitated pups after release (Tougaard 1996). However, an alternative approach might be to rethink and possibly consider some redesign of rehabilitation procedures for young pups according to developmentally valid criteria.[1] Three of the case studies reported here have suggested that a revised approach might incorporate a much shorter time in rehabilitation and an exclusively liquid, high-fat diet during this period. The success of both old and revised approaches should continue to be tested with follow-up studies after release.

Endnote

[1]Although this discussion relates specifically to harbor seal pups, similar consideration might be given to the rehabilitation of pups of the grey seal and other phocid species, with due regard being paid to differences between species in natural preweaning and postweaning developmental parameters.

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FROM THE LAST ISSUE... CASE VIII:

Feeling Bulldozed

The last issue of the Journal *featured a case in which the improper care of a young fox brought practical and strategic issues into question for a concerned rehabilitator. ...*

Karen, a licensed mammal rehabilitator, was frustrated. The previous week, a local construction crew had inadvertently bulldozed a fox den. They found one baby fox, who a crew member took to the nearest vet's office, operated by a Dr. Powell. A week after the accident, the crew worker's wife ran into Karen and told her what had transpired.

Since Karen had not been contacted by Dr. Powell's office, she called him and asked about the status of the fox. He told her the fox was fine and he would continue to raise him. The doctor's kennel technician had found information on fox diet on the Internet; however, they thought the recommended food too expensive and had substituted cow's milk and dog food. The staff was enjoying playing with the little animal.

Karen tried to reach her local wildlife officer, Henry Stone. It took two days for him to call her back. After Karen explained the fox situation, Officer Stone said he and his boss were both friends of Dr. Powell and he had decided to leave the animal at the clinic.

Karen told her friend Theresa that she didn't know what to do. She worried about the care the fox was receiving: If he did survive, would he become a nuisance animal? Would blame for the nuisance be placed on "bad rehabilitation"? If he was imprinted on humans would that be a problem? Would the fox transmit diseases or parasites to animals in Dr. Powell's clinic?

Theresa suggested going over the game officer's head and asking the state agency for action. Karen feared the long-term consequences of alienating both Dr. Powell and Officer Stone.

QUESTIONS FOR DISCUSSION:

1. What can a person do when the state wildlife agency staff does not enforce wildlife regulations? What are the risks of taking action?

2. What can rehabilitators do when they are in conflict with their wildlife officer or the officer simply does not like wildlife rehabilitation?

3. Rehabilitating or caring for wildlife is different from caring for an injured pet. However, many people experienced with companion animals are not aware of these differences or know the consequences of their actions. What can be done to change this?

4. What can be done when a veterinarian without a wildlife rehabilitation license keeps wildlife and refuses to surrender them to a wildlife rehabilitator?

5. What can rehabilitators do if veterinarians criticize and/or do not support wildlife rehabilitation? Or a rehabilitator?

6. Many Internet sites give suggestions on wildlife care. Some of the information is good; much is not. What can rehabilitators do about the proliferation of Internet information that can do harm to animals or humans?

RESPONSES

I.

Kieran Lindsay
Former Manager, Texas Wildlife Rehabilitation Coalition

Wildlife rehabilitation hasn't yet received much recognition or respect as a profession. It's still considered by many to be a hobby. While in most states a license or permit is needed to rehabilitate mammals, the education, training, and experience needed to qualify for a permit varies widely. One doesn't usually have to take a test, or be certified, or belong to a professional

Wildlife rehabilitators' interests range far beyond the direct care and handling of wildlife. Standards, ethics, wildlife policy, and community involvement are among the many issues that have a direct impact on the work rehabilitators do every day.

Since these issues benefit from broad public discussion, this section of the *Journal* is designed to offer a forum for wildlife rehabilitators to exchange ideas about challenging issues, which are "up for discussion" by you, our readers. Some of the cases may also be discussed at upcoming IWRC conferences.

The following cases will present either hypothetical situations or real-life problems facing active rehabilitators. Each case is followed with several questions for readers, and responses from people involved in wildlife rehabilitation. To encourage a free exchange of ideas, both attributed and anonymous responses are welcome.

Each issue of the *Journal* will publish a synopsis of the original case from the last issue, several responses, and a new case for your consideration. Please see page 29 for this issue's new case, and see the box on page 28 for details about how to participate.

Space may not be available for all responses submitted, and responses may be edited for space and clarity, but we will include as many responses as possible. We welcome your participation. Only with your help can this forum thrive.

NOTE: THE International Wildlife Rehabilitation Council makes no claims as to the accuracy or truth of the following cases, not does it endorse any particular answer or viewpoint.

organization. Is it any wonder that many wildlife/animal professionals don't take rehabilitators seriously? Wildlife rehabilitators are guilty of this kind of thinking, too. How many of us have dismissed as hopelessly unqualified the eager rescuer, full of information on how best to care for "their" animal?

Karen has tried her best to sway Dr. Powell. Unfortunately, she has no previously established credibility with him. Neither does she now have time to build the kind of working relationship that could, over time, bring him around to her way of thinking (and compliance with the law).

This is an instance when I would use peer pressure. I would suggest that Karen try to find a veterinarian in her state who does have a wildlife rehabilitation permit. I would then contact that veterinarian, explain the situation, and ask if they would be willing to speak with Dr. Powell. Although the same arguments are likely to be made, they will carry more weight coming from one of Dr. Powell's colleagues. In addition, the permitted veterinarian can help Dr. Powell understand the risk that caring for this animal presents to his patients and his business.

Dr. Powell may end up placing the animal with the permitted veterinarian, or with Karen, or with another rehabilitator. He may, alternatively, choose to continue caring for the fox, despite all efforts to dissuade him. And this is when it may be necessary for Karen to surrender the battle—but take steps to ensure that she will win the war.

If she wants to create real change, in both Dr. Powell and the wildlife officer, it will take a sincere commitment of time and effort. First of all, Karen should let Dr. Powell know that she is still willing to help, now and in the future. Then she should try to find information on the proper fox diet from a respected source and give it to Dr. Powell, along with any additional information on care—including disease issues. Karen should keep the lines of communication open and offer to work with other wild animals that may be brought to the clinic. Developing trust and respect takes time.

In the case of the wildlife officer, Karen has similar work to do. While there is still a good deal of good-ol'-boy, hook-'n-bullet thinking in fish and game agencies, the times they are a-changin'. The public has very different ideas about wildlife than were prevalent 25 years ago. Wildlife officers are often hesitant to confiscate wild animals from members of the public because of the bad PR it brings to the agency. The law may say that it's wrong to keep a "pet deer," but what organization wants to be portrayed in the local media as the bully who whisked away some tearful-eyed child's pet?

If we, as rehabilitators, wish to establish professional relationships with state and federal personnel, we need to spend some time thinking about their needs and limitations, not just our own. I'd suggest Karen begin by inviting her wildlife officer out for a cup of coffee and some nonconfrontational conversation. By offering to work with him to address some of the problems they share dealing with wildlife and the public, Karen will not only help herself and wildlife, she'll help the rehabilitation profession as well.

RESPONSES

II.

Penny M. Vaughan
Fort Myers, FL
Former Executive Director
Wildlife Response, Virginia Beach, VA

Sometimes we have to back away in order to see the entire picture. Regardless of whatever action was chosen, the fact remains that, like it or not, Officer Stone controls the future of Karen's rehabilitation efforts. In many areas—and especially in matters concerning wildlife—the good-old-boy system remains in place. It's noted that both Officer Stone and his boss hunt with Dr. Powell; Dr. Powell also treats their hunting dogs. Neither of these men see that it's wrong to keep the fox and to challenge them would be disastrous. Karen would find herself without support from the veterinary community (noting Dr. Powell is well liked), putting perhaps hundreds of her future charges in jeopardy.

Sometimes we have to sacrifice. We have to choose our battles carefully and this is one that probably will do more harm than good if pursued. If he's chastised, it would only be a matter of time before Officer Stone evened the score (in his book) and found a reason to revoke her rehabilitation permit. Does Karen save one fox—and forfeit the lives of all the animals that would *not* be coming to her door?

If one is going to "take on" the game department, the chances of success rise dramatically if a concept is challenged—such as failing to understand the contributions of wildlife rehabilitators (ultimately effecting many/all wildlife)—rather than an individual case that effects only one animal. I'm all for "going to the top" to change attitudes and, as we all know, it begins with education.

My grandmother used to tell me, "You can get more flies with honey than vinegar." How can we apply this old adage to further our rehabilitation goals? Karen started out by trying to inform Dr. Powell and his staff about wildlife's special needs. She's not going to save this one fox, but she might save future foxes (or whoever comes in) by biting her tongue now and continuing to touch base with the veterinary clinic. She might offer to have an informal chat with any employees interested in learning more about wildlife rehabilitation. Care must be taken not to become a pest, but to remain helpful and supportive. If the door of communication is closed, it's the wildlife down the road who suffer.

To address individual questions:

(1) In this particular case, check the regulations. Are game officers allowed to use some discretion in the disposition of an animal? If so, then Officer Stone enacted this right and Karen doesn't have a legal leg to stand on. Attitude is critical when dealing with the very agency that allows us to rehabilitate the wildlife who fall under its jurisdiction.

If the wildlife regulations are not being enforced then, using the department's chain of command, Karen should find out why and ask what they can do to help at her level. If she does this in a nonaccusatory manner, she'll get further.

(2) Keep a low profile. We cannot forget they have the legal power here; to challenge them is to loose. Going back to that honey and vinegar, perhaps by asking the officer to "stop by now and then—I'd like you to see what I'm doing," the rehabilitator can gradually win him over. Hopefully, he'll gain some insight into our purpose and value.

(3) Public education. Before or at the beginning of the next baby season, try calling the local newspaper to see if they would be interested in publishing an article about wildlife rehabilitation. They are always looking for human interest stories and many people find wildlife fascinating. Point out to the reporter how often people assume wildlife care is the same as companion animal care and ask their help in dispelling this myth. Be prepared with facts, knowing your words are helping educate those in your community.

(4) Again, weigh what you may win against possible losses. If the vet is keeping one animal, that's one thing. If he's keeping 100, that's another.

(5) The rehabilitator might make an appointment with the vet to sit down and discuss his views on rehabilitation. There might be a misunderstanding and there's always the hope that by getting to know the rehabilitator, the vet might become more supportive.

(6) Just as there are good and bad books available to the general public, there are also good and bad websites. We have no control over them. But then, would we want it? The best we can do is identify the good sites and when the opportunity arises, tactfully find ways to pass these on to the public.

RESPONSES

III.

E. P. Elliston
Wildlife Rescue Inc. of New Mexico

In response to question #1:

It's a little late to try to start cultivating one's state wildlife agency when faced with a particular animal crisis. This kind of relationship building is a long-term process, requiring attention and good humor for years. Getting to know the agency and its personnel at various levels in the hierarchy can provide alternative individuals to call for assistance when a crisis does occur. One thing that will be an immediate red flag to the agency, however, is giving the impression that somehow this animal is more needy/valuable/important than any other. Most agency personnel, even the "rod and gun" folks, are in the business because they love wildlife. They often see the species as more important than the individual, however, and also have liability issues to bear in mind. They are not about to encourage the cultivation of "wild pets" among the public, no matter how well this particular member of the public is permitted or educated.

State wildlife regulations are likely to be a lot more complex than many rehabilitators initially think. Mammal "protection" can come in a variety of forms—fur-bearer, game animal, rabies vector species, varmint...you name it—and these can differ from state to state. The first thing to do is to find out how the agency views the various species, and how they are prepared to deal with them. If rehabilitators can put themselves in the position of being viewed by their state agencies as welcome volunteer interveners in certain wildlife-human interface situations, they are much more likely to be able to solicit help from the agency when help is needed.

In response to question #6:

If anyone is contemplating trying to control the proliferation of Internet information they should think again. Not only is attempting to control information bad politics, it is a waste of time and energy. The only solution is to develop better alternatives to bad information. One thing rehabilitators can do to make beneficial resources available to the public is to help create that information and get it published on sites that have visible credentials. The two national organizations for wildlife rehabilitators both have sites on the Internet. They both have links to other reliable sites that may address species in greater detail. The IWRC site includes peer-reviewed material for the public to read when faced with a wildlife situation. Anyone who would like to submit a paper is welcome to do so by visiting the site and contacting the administrator.

JOIN THE CONVERSATION

On the following page, the *Journal* presents a new case. We invite you to read the case and consider the questions at the end. The cases are designed to raise complex issues, leaving plenty of room for varied or even contradictory perspectives. To join the conversation, send your response by January 31, 2000, to IWRC, 4437 Central Place, B-4, Suisun, CA, 94585-1633, USA (marked "ATTN: Up for Discussion"), or via email to iwrc@inreach.com.

The *Journal* also welcomes suggestions for topics to feature in future issues.

CASE IX:

Too Much of a Good Thing?

Sylvia Jackson was reflecting on her involvement with wildlife rehabilitation after a phone call with Helen Andrews. Many years earlier, she had helped two of her fourth-grade students reunite some "rescued" (she now used the term *kidnapped*) goslings with their mother. The experience had prompted her to call Helen, a longtime bird rehabilitator, and begin volunteering.

Sylvia was soon spending much of her time helping Helen, who became her mentor and close friend. By the following spring, Sylvia had her own state and federal rehabilitation permits. She specialized in waterfowl, but accepted a limited number of injured adult songbirds.

Helen had just told her that she had decided that she would no longer rehabilitate Canada geese. First, Helen said, much of their former local habitat was now used for agriculture or various kinds of urban development; she felt that there was just not enough good habitat left for them. Second, many of the Canada geese had concentrated in a few areas and become nonmigratory; the rapidly expanding local populations caused problems in the area for people as well as for other waterfowl.

Third, the state wildlife agency had recently begun a program of "geese roundups," which involved trapping geese who were allegedly harming local wildlife populations and habitat. The agency had taken the geese and released them on a lake ringed with hunters the day before hunting season. The agency had said that they were even considering taking future trapped geese to a "processing" plant where they would be destroyed. Helen had always understood that some rehabilitated Canada geese would be part of the food chain, including those taken by hunters. She considered the idea of sending them to a processing plant, however, to be the last straw. In the future Helen planned to concentrate on rehabilitating other birds, for whom she felt she could make more of a difference.

This phone call had caused Sylvia to consider what *she* should do regarding the Canada geese situation. She had recently talked with local Audubon and Sierra Club chapters about the problem of habitat loss and degradation.

The state wildlife agency's new roundup program involved trapping Canada geese and releasing them on a lake ringed with hunters. Furthermore, the agency was considering taking future trapped birds to a "processing plant," where they would be destroyed.

The conservationists were also very concerned about these issues, as well as the pressure the geese were placing on other, more sensitive species. Sylvia, too, was disturbed by the wildlife agency's plan to trap and relocate or kill the geese, but appreciated that they were under pressure to "do something." She was probably least concerned about people who didn't like the geese droppings on their yard, park or golf course, but considering the growing number of complaints in the newspaper, they were going to press for action. Sylvia sighed and wondered what to do.

QUESTIONS FOR DISCUSSION:

1. **Many species are facing serious habitat loss. What might rehabilitators do about this issue?**
2. **Human-wildlife conflicts are becoming increasingly common, including impacts from concentrated wildlife populations. What might be done to help resolve such concerns?**
3. **Some species (e.g., Canada geese, starlings, English sparrows, cowbirds, white-tailed deer) have adjusted to living around humans and in modified habitats. In some cases, this has placed pressure on other more sensitive species. What are some of the options for rehabilitators faced with this situation?**
4. **Wildlife agencies have a responsibility to manage wildlife populations. If they feel that a particular population is becoming a threat to wildlife or habitat, drastic action may occur. How can rehabilitators be proactive and participate in influencing wildlife policy and action?**
5. **What are some of the options for dealing with rapidly expanding nonmigratory Canada geese populations?**

A Small Feeding Nipple for Flying Squirrels

by Bobbie Binns
1281 Quail Hollow Drive
Hamilton, GA 31811
bbinns@mindspring.com

Several years ago, when I received my first pinkie flying squirrel, I was faced with the problem of finding a nipple that was small enough to fit into the tiny mouth of a creature no larger than a jelly bean. Nothing that I had used up to that point was satisfactory for this little guy...the usual small size catac nipple was bigger than the baby I was trying to feed!

One night while I was at work as an RN in a busy hospital emergency room, I started looking around to see if I could find anything small enough to fit a newborn flying squirrel's mouth. The following are three options I discovered to be acceptable both to the baby and me. You should be able to obtain most of the supplies for making these from your veterinarian or from other medical professionals.

The basis for the nipple in all three devices is the grey rubber sleeve that covers the needle of a multiple-sample blood collection needle used by hospitals, veterinary clinics, and labs to draw blood. This device appears in the upper left corner in each of the photos. I use Vacutainer brand; Sherwood brand may be used as an alternative.

I first push the grey rubber cover down over the needle, allowing the needle to pierce the rubber. This creates a perfectly sized hole in the nipple. Then I select one of the following three devices to act as a foundation for the nipple, allowing it to be easily attached to the syringe.

1. Teat Cannula By sliding the little grey nipple onto the tip of a teat cannula, you have created a device that would easily attach to the tip of any (luer slip) syringe (Fig. 1).

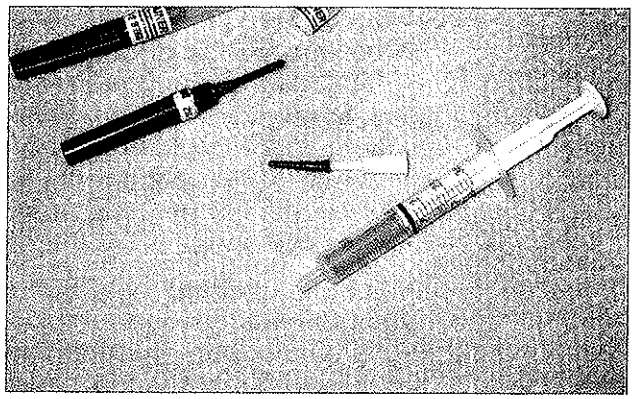


FIG. 1. A teat cannula with the nipple attached to it is shown next to the syringe it will be used with.

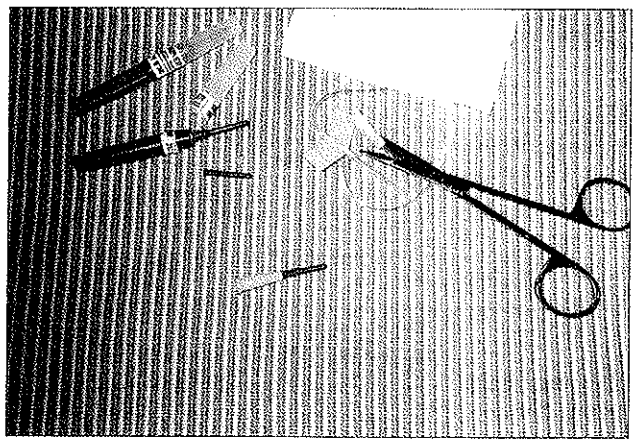


FIG. 2. Butterfly IV Catheter Hub shown with the nipple covering the remaining 1/4" section of tubing. Also shown is the entire Butterfly Catheter with the scissors about to cut the tubing 1/4" from hub.

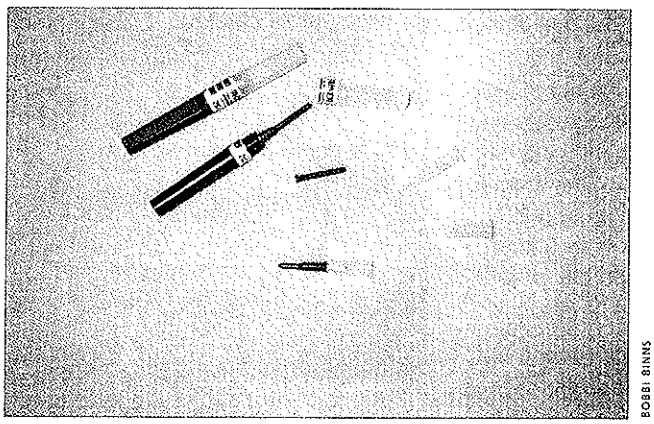


FIG. 3. Needleless IV Injection Cannula is shown here with the nipple covering the tip. (NOTE: Uncovered sample of the Needleless device at right side of picture.)

2. Butterfly Catheter The foundation for this nipple is created by cutting the clear plastic tubing on a Butterfly IV catheter 1/4 inch from the hub and then sliding the nipple onto this little stub of tubing. If you have problems sliding the nipple onto the tubing, try lubricating it with jelly (Fig. 2). You can obtain a Butterfly IV catheter from your veterinarian or the supplier listed below.

3. Needleless Cannula Most hospitals now use the Needleless IV System, which uses a tiny plastic cannula that attaches to a syringe and is used to pierce the medication ports of IV tubing. Since this device never touches anything but the IV tubing itself there is no reason it can not be reused as the foundation piece of this nipple. The nipple easily slides onto the tip of this

cannula, which then attaches to the syringe (Fig. 3). If you are unable to obtain one of these from your vet, try asking your local hospital's emergency room if they would save a few for you. (Becton Dickinson is a supplier for these, but since you would need so few it probably would not be practical to order them.) The cannula tip can be reused indefinitely when the nipple wears out.

I have found these little "nipples" work very well for pinkie flying squirrels, very small opossums, and pinkie grey squirrels. One rehabber I know plans to try one the next time she takes in a neonate bat.

PRODUCT SUPPLIERS

Teat Infusion Cannula
(Catalog no.: 00908; $3.45/100)
May be obtained from:
Omaha Vaccine
P.O. Box 7228
Omaha, NE 68107
800/367-4444

Vacutainer Brand multiple-sample blood collection needles
(Catalog no.: 367213)
May be obtained from:
Becton Dickinson Company
1 Becton Drive
Franklin Lakes, NJ 07417-1883
800/237-4554
http://www.catalog.bd.com/scripts/catalog.exe

Sherwood Brand multiple-sample blood collection needle **($10.65/box)**
Intermittent Small Vein Butterfly Catheter 12 Tubing **(40 cents each)**
May both be obtained from:
MedCare Products
246 East 131st Street
Cleveland, OH 44108
800/633-2273
medcare@raex.com
MedCare adds a $5 handling fee to all orders that total less than $50

Note: Anyone having problems tracking these supplies down may send me a stamped, self-addressed envelope and I will be happy to send you a sample "nipple."

Protection from Quills

by Sue Meech
Napanee, Ontario, Canada

Last year I encountered my first porcupine, whom I dubbed Spike because every time I picked him up with a towel, I removed hundreds of quills. Most of these remained on the towel, but some even went through my gloves into my skin.

A friend suggested the following method of protecting hands. Give it a try: it works.

Take a sheet of thick but flexible plastic, rubber, or vinyl such as an old picnic table cover and throw it over the porcupine, covering him from snout to tail. The tail is especially important as even a one-week-old baby can use it as a spiked club. To make holding the porcupine easier, throw a towel over the plastic. You can then tuck the two layers under the porcupine's belly, where there are no quills, and pick him up.

The good news is that porcupines are gentle creatures who become friendly very quickly. Within seven days we were bottle feeding using a "hands-off" approach.



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MONTREAL, QUEBEC, CANADA
OCTOBER 25–29

Hummingbirds: A Wildlife Handbook

(Johnson Nature Series #3)

by Kim Long

The hummingbird family is a fascinating group of birds with many unique characteristics. Since I have had the privilege of raising and rehabilitating hummingbirds, I was excited when a "handbook" devoted to this family showed up in the library where I work. In this 182-page book, Kim Long combines the components of the typical field guide, companion book, trivia book, and species-specific book.

The results are mixed. On the one hand, it is wonderful to have so much information in one easily used source. On the other hand, some of the information in the narrative sections is questionable. Without footnotes it is difficult to verify the information without exhaustive research using the extensive bibliography. Another rehabilitator who read the book commented that it appeared that some major primary sources had been omitted from the bibliography. These criticisms notwithstanding, I still recommend the book for its collections of diverse information in one handy source. To get all this information on hummingbirds otherwise would require several books of the types mentioned above, as well as access to scientific papers.

The book is arranged in 28 titled sections, but can be divided roughly into three major categories—origins, field guide, and miscellaneous facts and articles. The first part of the book deals with origins, incorporating some of the myths and legends of hummingbirds from various cultures, followed by a chapter on the origins of the names of 17 species of hummingbird. Part Two is a field guide and more. Here 15 species of North American hummingbirds each get a standard four-page treatment. The first page features a large illustration of the male and female of the species. The facing page contains vital statistics, including the official and scientific names, common names (usually only a common Spanish-language name), description, comparison, and measurements. The measurement information is fairly rare in this type of guide in that it includes not only total body length in U.S. and metric measurements, but also wing length, bill length, tail shape, and weight. This is a valuable feature for the rehabilitator working with hummingbirds.

The food and breeding sections should be of particular interest to rehabilitators. The food section lists various plants that I presume are primary nectar sources for that species. When listed, animal food sources may be indicated in a general way, for example insects and spiders, or sometimes in a slightly more specific way, for example, ants or aphids. The breeding section includes information on the time of year or months when mating occurs, nest description, number of eggs, incubation, and first flight. It also includes number of broods per season when a species is known to have more than one.

The last page for each species is a "range map" covering only Canada and the United States. Pale green is used to indicate the "traditional" range, "including some migratory areas." Labeling it "breeding" range would have been clearer. Pale pink is used to show the "normal migratory area outside of breeding territory"; a medium green dot indicates the states outside of these ranges in which the species may be sighted. The winter range is described in the text, but not shown on the maps.

The remainder of the book consists of miscellaneous articles that address, among other things, anatomy, molting, body temperature, flight, and reproduction. Each topic is prefaced by a related observation from noted writers such as Charles Darwin, Charles Dickens, and R. Ridgway. There are numerous interesting comparison charts, diagrams and fact boxes in this part of the book. For example, the 15 species covered by the book are shown in white silhouette drawings comparing body size, bill shape, and tail shape. There are good drawings of a newborn hummingbird shown enlarged and actual size, and a drawing showing four different hummingbird nests. These black-and-white drawings are more successful than the colored illustrations in the "field guide" portion of the book, which lack the finesse of the Peterson, Golden and National Geographic field guides.

The book includes a list of resources for wild bird information, a list of resources for hummingbird feeders and supplies, a list of on-line resources, a lengthy bibliography, and an extensive index. At $16 this a good general introduction to hummingbirds. Those needing more information will have a good start by using the bibliography.

—Reviewed by Michele A. Gillert

Johnson Books
Boulder, Colo.
1997
$15.95

Walker's Mammals of the World (Sixth Edition)

by Ronald M. Nowak

This 1,919-page, two-volume set on mammals was an enormous undertaking. The text has expanded and improved in myriad ways from the first edition in 1964. This sixth edition covers every genus of mammal known to have lived in the last 5,000 years; the animals covered range from the

long-extinct woolly mammoth to Southeast Asia's recent discovery, the giant muntjac.

Walker's original intent was to serve not only the professional mammalogist but to provide a comprehensive account that would be helpful to the public as well. Perhaps it is this fact that makes this set unique.

As one might expect in a work so large, there are problems. However, these, although bothersome, do not detract significantly from the work. The photos are in black and white to save printing costs, and the quality that may have been present in the original color may have lost something in the translation. This is especially significant for readers who are not professional mammalogists who are using the text as a reference for species identification. Not all species are pictured. However, the editor makes a request that individuals with good photos submit them to improve future editions.

The extensive bibliography is enormously valuable for writing research papers or journal articles or for seeking additional information on a species. Virtually all scientific literature relevant to mammals seems to have been logged and referenced. One can only imagine the painstaking, exhausting process this must have entailed.

Each order of mammals is given a complete introduction. This includes separate accounts for each of seven orders of marsupials. Information on each animal is condensed, but as complete as one would expect in such a large reference. Material on each animal includes measurements, natural history, species relationship to humans, and important information regarding economic value and conservation.

This reference is a bargain. It would be a valuable addition to every center that works with mammals, or handles telephone calls from the public on wildlife issues. I feel infinitely more comfortable knowing that I have information close at hand should an unfamiliar mammal, indigenous or introduced, require my attention.

—Reviewed by Marge Gibson

Johns Hopkins University Press
Baltimore and London
1999
$99.95

Wildlife-Habitat Relationships: Concepts and Applications
(Second Edition)

by Michael L. Morrison, Bruce Marcot and R. William Mannan

This book is scientifically oriented and not for every rehabilitator. The material within, however, is well worth reading and understanding.

Science and wildlife rehabilitation are edging closer together and will overlap with greater frequency in the new millennium. This occurs as the level for excellence rises not only for animal care in captive situations, but for postrelease information as well. Appropriate habitat has always played an important part in the release of rehabilitated wildlife. This book explains the concepts that sometimes elude those without a background in biology.

Some of the chapter titles are:

- The Study of Habitat: A Historical and Philosophical Perspective
- Measurement of Wildlife Habitat: What to Measure and How to Measure It
- Measuring Behavior
- Habitat Heterogeneity and Responses of Wildlife
- Modeling Wildlife-Habitat Relationships

The book addresses such concepts as the importance of sample size, and explains why adequate numbers are important to be scientifically relevant. There are few things more frustrating than finishing a postrelease project only to find it holds no scientific value.

This book explores many of the issues that have been at the root of misunderstanding between scientists and wildlife rehabilitators for as long as the two have had occasion to interact. Some of the topics are clearly meant for the wildlife manager. However, they will help rehabilitators develop a basic understanding of other wildlife professionals who they may encounter through a long wildlife rehabilitation career.

The authors have a straightforward and candid manner. This is helpful to readers who may be struggling to understand new concepts from unfamiliar disciplines. While not an easy read, *Wildlife-Habitat Relationships* is an excellent book to have in your library as a reference. It is a must if you are entertaining the idea of doing some serious postrelease work in the future.

—Reviewed by Marge Gibson

University of Wisconsin Press
Madison, Wisc.
1998
$26.95

Bats of the United States

by Michael J. Harvey, J. Scott Altenbach, and Troy L. Best

There was a time, not very long ago, when it was quite unusual for members of the public to rescue bats and bring them to a wildlife rehabilitator. Bats have suffered from bad PR

throughout history and only recently, through the tireless efforts of Bat Conservation International and other like-minded groups, have people begun to appreciate this fascinating and highly beneficial species.

For almost 15 years, the Arkansas Game & Fish Commission has taken an active role in developing and publishing booklets designed to increase appreciation of bats. *Bats of the United States* is the latest addition to the series. Dr. Michael J. Harvey of Tennessee Technological University wrote the Commission's first two bat publications, and is the primary author here. Dr. Harvey has spent much of his life learning about bat distribution, biology, and conservation. Dr. Troy L. Best of Auburn University has done extensive research on the bats of the southeastern and southwestern United States. Dr. J. Scott Altenbach, University of New Mexico, Albuquerque, has studied the bats of the western states for many years. Dr. Altenbach also is one of the world's best bat photographers.

Bats of the United States begins with a straightforward introduction, with brief descriptions of bat biology, echolocation, feeding behavior, hibernation and migration, and reproduction. The authors go on to discuss the agricultural benefits bats provide and threats to bats, and offer an overview of research and conservation efforts. Most of the book, however, is given over to species accounts for 45 of the 54 bats found in the U.S.

From a rehabilitation standpoint this book could prove invaluable. Each page includes a large photograph, an easy-to-read distribution map, weights, wingspan, and reproduction data. Behavioral information includes habitat, preferred roosting sites, and emergence times.

I've not come across another source of information on the preferred diet of each species. Bat books generally explain which species eat insects, pollen, nectar, or fruit. *Bats of the United States* provides specific information on the types of insects each species prefers. For example, Seminole bats (*Lasiurus seminolus*) forage around and in the tree canopy, so their diet consists largely of flies, mosquitoes, and other flying insects. On the other hand, moths gleaned from buildings and tree trunks are a primary food source for southwestern bats (*Myotis auriculus*).

Species accounts include some valuable information on reproduction. Specifically, descriptions of newborns are provided for many species, as well as the usual number of offspring, when they are born, whether the young are carried or left behind while the mother forages, and—in some cases—the age at which the pups are weaned and learn to fly.

In-flight photos are less helpful from an identification standpoint than the close-ups of stationary bats, and in these cases a written description would be helpful. The book does not include a biological key for identification, but since it was written for the general public (who are discouraged from handling bats), I can't criticize the authors too harshly for this omission.

Rehabilitators who work extensively with bats could certainly benefit from this inexpensive addition to their reference library. And since *Bats of the United States* is published for nonprofit distribution, rehab centers may want to contact the Commission for information on obtaining multiple copies.

—Reviewed by Kieran Lindsey

Arkansas Game & Fish Commission, 2 Natural Resources Drive, Little Rock, AR 72205, USA; 800/364-4263
1999
$5

Fun with Nature: Take along Guide

by Mel Boring, Diane L. Burns, Leslie Dendy

Illustrations by Linda Garrow

The target audience of children aged nine to 12 will find this book fascinating. The format is equally successful when used in outdoor classwork, for classroom study, read for pleasure, or used as a reference.

The book is divided into six sections, each of which is a lesson in itself. The topics—listed below—are an interesting mix, easily observed in nature by children, and designed especially with this age group in mind:

- Caterpillars, bugs, and butterflies
- Frogs, toads, and turtles
- Rabbits, squirrels, and chipmunks
- Snakes, salamanders, and lizards
- Tracks, scats, and signs
- Trees, leaves, and bark

The text is clear, accurate, and cleverly presented. Colorful renditions illustrate the subject matter. The appealing result will pull young readers into the material and encourage them to read on. *Fun with Nature* includes interesting facts for each new species presented, in addition to the usual "what," "where," and "how" material found in many wildlife texts.

A nice touch that further distinguishes *Fun with Nature* from other children's nature books is the liberal sprinkling of "Wise Words" throughout the book. Functioning almost as a conscience for readers, they are delightfully couched so as not to be condescending. Blank pages are included at the end of each section for the young reader's use. These provide a wonderful place to save those

"treasures" of the wilderness that many youngsters find hard to part with.

I highly recommend this great book to get young people actively involved with wildlife and habitat at the same time.

—*Reviewed by Marge Gibson*

Northword Press
1999
$14.95

Turtle Spring

by Deborah Turney Zagwyn

This book, written for children ages three to eight, may attract parents and grandparents by its beautiful illustrations. Five minutes of reading, however, will leave the rehabilitator's heart cold.

The story centers on a turtle that a young girl receives from her uncle, Fishtank Hal. The turtle destined to be a "pet" is a red-eared slider. We first encounter the turtle when Fishtank Hal brings her to the child's home. "I have brought something for Clee," he boomed. "She's bungeed to my bike and she ain't happy about the trip!" Horror among horror: a picture of a happy little girl, her uncle, and a panicked red-eared slider strapped to the back of a motorcycle accompanies these lines.

The rest of the story attempts to describe turtle hibernation. This goal might have been the saving grace of the book. However, a consistent lack of responsibility by any adult in the story overrides its good intentions. There is no attempt to assist the young child with proper care of the turtle, although the mother repeatedly says the turtle is a southern species in a northern climate zone. The turtle is regarded as an object more than a living creature.

This book has little to recommend it. Rehabilitators and wildlife professionals might be best to avoid using it as a tool—except as an example of thoughtlessness and irresponsibility. I won't let my grandson near it until he is old enough to make his own criticisms.

—*Reviewed by Marge Gibson*

Tricycle Press
Berkeley, CA
1998
$15.95

RESEARCH FELLOWSHIPS: WILDLIFE CONSERVATION SOCIETY

SPONSOR: Wildlife Conservation Society (WCS)

PURPOSE: To support small grants to field research projects leading directly to the conservation of threatened wildlife and wildlife habitat.

DEADLINE: July 1, 2000

SUMMARY: WCS's strategy is to conduct comprehensive field studies of wildlife needs, train local conservation professionals, and work with in-country staff to protect and manage wildlife and wild areas for the future. International Program staff work closely with other specialists at WCS's Bronx Zoo headquarters in New York, including the Wildlife Health Center and Field Veterinary Program, the Science Resource Center, and the Curatorial and Education departments.

The Research Fellowship Program (RFP) awards small grants to field research projects leading directly to the conservation of threatened wildlife and wildlife habitat. RFP applications must demonstrate strong scientific merit as well as direct relevance to wildlife conservation.

The RFP will support field work on a wide spectrum of wildlife species, habitats, and conservation issues. Previous RFP Fellows have conducted surveys of the population status of endangered species, investigated ecological processes in rainforests, savannas, and wetlands, analyzed the effects of habitat disturbance on wildlife, and assessed the impacts of management strategies.

For more information, visit www.usalert.com/htdoc/usoa/fnd/any/any/proc/any/wcs11039901.htm

Matching Keywords :

- Ecology
- Ecology, Aquatic
- Ecology, Wetlands
- Environmental Biology
- Fellowships