Harbour seal pup stranding and rehabilitation in the southern North Sea in relation to pup production

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Harbour seal pup stranding and rehabilitation in the southern North Sea in relation to pup production

Background

The southern North Sea is bounded by coastlines with offshore sandbanks bearing relatively high populations of harbour (common) seals, *Phoca vitulina vitulina*. Since the early 1970s ‘orphans’, sick or otherwise disabled pups stranded along the shoreline have been taken into human care, rehabilitated and released back into the wild both in the Wash area of East Anglia and along the Wadden Sea coastline from Denmark to the Netherlands. This practice has grown over the past 40 years from just a few orphan pups to several tens of pups in each area every season, and has become a few hundred pups along the coastlines of Germany and the Netherlands in recent years.

For the purposes of this document, ‘pups’ are considered to be seals in their first year. ‘Orphans’ are pups which have become separated from their mother in the neonatal period. In the 1970s, the relatively small number of pups were ‘orphans’ which were stranded on a public beach without their mother in attendance, and the number of such orphans has steadily grown in the Dutch part of the Wadden Sea since the 1970s (Osinga and ‘t Hart, 2010). In the 1970s, 80s and 90s older pups suffering from severe lungworm infections were sometimes also taken for rehabilitation, and the numbers of such pups rose dramatically from the late 1990s.

The rescue and rehabilitation of seal pups acquired a higher public profile in the immediate aftermath of the 1988 phocine distemper virus (PDV) epizootic, and more formal regional seal rehabilitation ‘hospitals’ and centres began to be established around that time.

The harbour seal population in the southern North Sea suffered hunting pressure until the late 20th century. In the UK the hunt was mainly for pups, and this stopped with the introduction of the Conservation of Seals Act 1970. The largest UK population in the southern North Sea is the in Wash (Fig. 1), and this population then recover in the post-hunting era from ~1500 seals around 1970 to 3000 in 1988. The total harbour seal population along the Wadden Sea coasts (Denmark, Germany and Netherlands) at the turn of the 19th century has been estimated at c. 37,000, including about 11,500 in the Dutch Delta area, but was severely depleted by hunting until 1962 (Wolff, 2005) and then due to PCB contamination levels during the 1960s-1980s, particularly in Dutch waters (Reijnders, 1982; 1986). The population gradually increased from ~4000 counted in 1975 to ~10000 in 1988.
In 1988 both the Wash and the Wadden Sea populations suffered heavy mortality from PDV, with the Wash population falling from ~3000 back to ~1500 seals and the Wadden Sea population from ~10,000 back to ~4,000. In 1989 there were estimated to be only c.500 seals left in the Dutch Wadden Sea (Toorn, 1996) and fewer than 10 in the Dutch delta area (Witte et al., 1998). Both populations increased again, to ~3,000 counted in the Wash in 2002 and ~20,000 in the Wadden Sea in 2002. The average annual rate of increase 1989-94 was 16%, which was highest in the Netherlands (21%) (Reijnders et al., 1998).

The second PDV epizootic in 2002 (Harkonen et al, 2006) reduced both populations again, the Wash back to ~1800 and the Wadden Sea back to ~11,000. There have been no large scale epizootics since 2002, and both populations have enjoyed uninterrupted growth, to August moulting counts of ~3000 again in the Wash by 2010 and ~24,000 in the Wadden Sea in 2011. This has represented a 12% p.a. increase in the Wadden Sea (Reijnders et al., 2009). All harbour seals in the Wadden Sea are now legally protected under the 1990 International Wadden Sea Agreement, the principle aim of which is to achieve and maintain a favourable conservation status.
The population increases have been accompanied by changes in the ratio of pup births to the total population. The post-1988 epizootic the ratio of pups to the total population was higher (21%) than before 1988 (13%). In the period 2003–2009 the ratio increased to 27%, suggesting that the population age structure may still be dominated by adult females and has not yet returned to normal (Reijnders et al., 2009). Between 1974 and 2009 the average birth date has shifted forwards by 0.7 days/yr in all areas of the Wadden Sea. This is thought to be due to increased food availability in the pre-implantation period, resulting in shortening of the delayed implantation period and hence of the annual cycle (Reijnders et al, 2010).

The 1990 Wadden Sea agreement allows for institutions to be designated to ‘take’ ‘diseased or weakened or evidently abandoned suckling seals’ (as well as disabled older seals) for either euthanasia or rehabilitation and subsequent release. However, reservations about the biological impact and ethics of large-scale human intervention and rehabilitation began to be voiced (eg Schwarz and Heidemenn, 1992; Toorn, 1996) and the ‘Leeuwarden Declaration’ (LD s. 60) 1994 agreed ‘to reduce the taking of seals to the lowest level possible’, since it was considered that such taking was not necessary to maintain the population and could even have negative effects on seal population ecology.

Since the Leeuwarden Declaration, Denmark decided that seal rehabilitation and release should be discontinued in that country, the reasons for the decision including the rapid growth of the population and the potential impact on the population of releasing large numbers of seals after a prolonged sojourn in a human environment. Germany deploys federally authorised game-wardens hunters to monitor stranded seals and decide whether to euthanise stranded pups or bring them to a rehabilitation centre. Stranded pups in the Netherlands are not normally euthanized and are all brought to rehabilitation centres; the SRRC at Pieterburen is licensed by the Dutch government to enter seal reserves for the purpose of identifying and taking pups for rehabilitation. In the UK at present there are no legal restrictions on taking pups for rehabilitation.

Over the 5-year period 2000–2005, a total of 2033 seals (mostly pups) were taken for rehabilitation, including 792 (15% total pup production) in the Netherlands (Reijnders et al., 2009). These numbers have since risen in the Netherlands to over 300 in 2011, although the age class of these pups is not known. These high numbers of stranded pups may be partly due to the increasing population. Disturbance has been suggested as a possible contributory cause of the strandings in the Netherlands (Osinga et al., 2012), although this has not been confirmed. Pollution has also been suggested (Osinga and ‘t Hart, 2010), although again there is no evidence for this.

The aim of this workshop was to draw together biologist and rehabilitation centre expertise to analyse pup stranding data from both Wash and Wadden Sea centres in order to look at stranding patterns from different regions. From these, the aim was to consider measures which may be taken to respond most effectively to seal pup strandings, considering animal welfare as well as being compatible with management and conservation of a healthy and robust harbour seal population.

Workshop participants in Lincolnshire (East Anglia), Denmark, Schleswig Holstein and Niedersachsen have contributed stranding data from their areas. SCS has attempted to analyse these data in such a way that comparisons between regions are meaningful, although with the realisation that regional Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
comparison is difficult due to differences in habitat and criteria for taking pups into rehabilitation. The analysis for each region is presented in Appendices A–D. The present document attempts to compare and summarise the data from each region, draw some conclusions and make suggestions for the future.

**Regional comparisons of pup stranding patterns**

**Number of pups in rehabilitation as a percentage of pups in regional population**

The actual percentage for the Wash area is probably 2–3X the 4–7% that shown for Lincolnshire, since there are also two major (and one small) rehab centres in Norfolk for which there are no data at present. The percentage of total pups in the regional population entering rehab seems to be lowest in Schleswig-Holstein, at 2–4% (Fig. 2). The figures for Niedersachsen are in the region of 6.5–10.5%, i.e. probably similar to (or slightly less than) the estimated total for the Wash area (Fig. 2). The approximate figures for SSRC Pieterburen in the Netherlands are the highest recorded, at 16.5–20.5% in 4/5 years 2003–07 and ~24% in 2011. To these figures should be added the number of rehab seals at Ecomare in the northern Netherlands, probably making the Netherlands total higher by about 20% of the SSRC figure, which would lead to a total rehab estimate in the Netherlands of up to 20–24% in 2003–07 and 30% in 2011.

![Fig. 2. Number of pups in rehab centres as a percentage of total pup count in regional population. Lincs: data from 2 of 4 major rehab centres covering Wash area; S-H: data from Friedrichskoog; N-S: data from Norddeich; NL: data from SSRC Pieterburen (Osinga and 't Hart, 2010), the larger of 2 rehab centres in NL.](image)

**Pup stranding according to weight**

As discussed in Appendix C, the proportion of rehab pups in each weight category was similar in Friedrichskoog and Norddeich, apart from the greater number of larger (older) pups ≥14kg at Norddeich. When the % of Lincolnshire rehab pups in each weight category were compared with those in the German centres, it is clear that there were relatively fewer pups in the lower (neonate)
weight categories and relatively more in the older (≥ 14kg) pup category, i.e. 55% in the older category in Lincs, compared with 27% at Norddeich and 3% at Friedrichskoog (Fig. 3). The reason for this is probably the considerable distance of the two Lincolnshire sanctuaries from the main pupping areas (Appendix A), so that most pups stranding along the Lincolnshire coast are likely to be pups weaned at the Wash pupping sites and subsequently dispersing to potential foraging grounds outside the Wash. It is likely that the two main sanctuaries in Norfolk (Hunstanton and RSPCA at East Winch) tend to receive a higher proportion of ‘orphan’ pups, though this has to be confirmed. The two German sanctuaries each receive pups from all along the coastline in their respective states. It could be useful to have a chart of the Wadden Sea coastline showing harbour seal pupping and stranding areas.

**Fig. 3.** Percentage of pups stranding in each weight category in different regions

**Pup stranding according to season**

In all regions of the Wadden Sea most pup strandings were in the June-July pupping season, with a second peak in October-January. The Lincolnshire pattern was slightly different, with more pup strandings in the August-September post-weaning period than in the pupping season (Fig. 4). As discussed above, the high exceptionally high percentage of pups in June-July in Friedrichskoog is because the pups euthanized *in-situ* are not included in these data, and presumably involved mainly pups stranding later in the season. We hope to include data on euthanised pups in a later edition of this report.
Fig. 4. % pups recorded in each region stranding in each season

LinCs: recorded strandings and rehab are same; S-H: pups euthanized in situ not included; NS: rehab and euthanized pups; NL: rehab 'orphans' and seals with parasitic pneumonia only, from Osinga & 't Hart (2010); DK: all recorded strandings of seals <120cm.
Selective euthanasia of stranded pups in Denmark and Germany

Denmark and both Schleswig-Holstein and Niedersachsen in Germany have been pursuing a policy of euthanizing live-stranded pups which are believed to be too sick, badly injured or non-viable to be able to recover satisfactorily. In Denmark stranded seals (of all ages) are either euthanised *in situ* by rangers or left with no intervention. In Germany stranded seals are either euthanized *in situ* by game-wardens, or brought to the rehabilitation centres at Friedrichskoog or Norddeich if they are deemed to be viable.

Data on numbers euthanized were not available for Schleswig-Holstein at the time of the workshop, although we hope to include these in a later edition of this document. Data from Denmark (2003–10) may perhaps best be compared with data from Niedersachsen (2009–11) by considering the percentage of live-stranded seals in each season (estimated to be ≤ 1 year) euthanized and either left with no intervention (Denmark) or brought to Norddeich rehabilitation centre (Fig. 5).

![Graph showing % live-stranded seals ≤ 1 year euthanised *in situ*](image.png)

**Fig. 5.** Comparison of levels of euthanasia of live-stranded pups (est ≤1 yr) in Denmark and Niedersachsen

From this it is clear that Denmark generally euthanizes a higher percentage of stranded pups than does Niedersachsen, with the highest percentages being in June-July (presumably mainly ‘orphan’ pups) and Feb-May. Niedersachsen has euthanized ~27–44% of stranded pups and taken the remainder for rehabilitation, with highest levels of euthanasia in October-January (probably mostly pups aged 3–6 months with severe lungworm infection).

Pup death in rehabilitation and survival to release

The percentage of pups of each weight category dying during rehabilitation in the German sanctuaries was generally highest for the smallest pups and decreased to ~11kg, but then rose again for larger/older pups. For Lincolnshire generally 20–30% pups of around birth weight or less died, with the percentage deaths falling slightly for older pups. The reason for the apparent higher death rate amongst ‘orphan’ pups in Lincolnshire may be at least partly that all pups in Lincolnshire are brought to rehab, with none euthanized *in situ*.
Condition of stranded pups

The Lincolnshire records included observations on the initial condition of all stranded pups. Pups with no visible injuries or infections were most frequent in orphans stranding in June-July, but progressively less common as the season progressed (Fig. 5). Mouth infections (including mouth, jaw and muzzle infections or bleeding) were commonest in post-weaning pups stranding in August-September and next most common in pups aged 3–6 months in late autumn and winter (Fig. 5). Wounds (including bleeding from the rear flipper area and also dog bites) were equally common in August-September and October-January. Lungworm (suspected or confirmed) was commonest in pups aged 3–6 months (Fig. 5). Osinga et al (2012) also noted that lungworm infection in dead-stranded seals in the Netherlands up to one year old was commonest in late autumn and winter. The Danish data indicated that the incidence of lungworm seemed to increase up to 2006, and remain at a fairly steady level since then.
Discussion

Is there something wrong with the harbour seal populations in the southern North Sea?

The harbour seal populations in the Wash and in all parts of the Wadden Sea are evidently thriving in terms of numbers. In order to assess whether there is a problem with general population health in the southern North Sea, we would need to have all stranding data recorded, to include pups found dead as well as live pup strandings, and we would need the dates, age estimates and diagnoses for live strandings. For this purpose the data collected in this document are incomplete: data on mortality are not included in this document. Complete live-stranding data are included for Denmark and Niedersachsen, but not for the Wash/Lincolnshire or the Netherlands. Total numbers of pups in rehabilitation are available from previously published papers from one of two main rehabilitation centres in the Netherlands, although dates and age estimates are not given.

Nevertheless, making allowances or these deficits, it seems that the overall live strandings are probably less than 10% of pup production in all Wadden Sea areas except for the Netherlands and Denmark, where the live stranding rate seems to be 20% or more in some years. The recorded stranding rate in Lincolnshire seems to be of a comparable order of magnitude to the German rate, although data from the main rehabilitation centres in Norfolk are not available at present. These live stranding rate estimates are possibly not exceptional when compared with natural mortality data from elsewhere where humanitarian intervention is not practiced, although such data are sparse. One dedicated study of P.v.r ichardsi in Washington state found that neonatal mortality (up to one month) recorded in dedicated searches was variously 12%, 16%, 18% and 26% in different areas, with premature births, still-births and coyote attacks accounting for about three-quarters of these deaths and pre-weaning starvation – equivalent to live strandings in the present study – for only one quarter, i.e. an approximate average of 3–9% (Steiger et al, 1989). Pre-weaning mortality
(where there was no humanitarian intervention) was recorded for P.v. concolor as 12% on Sable Island, NS (Boulva, 1971) and 7% in California (Allen 1980).

The Wadden Sea populations have suffered two major PDV epizootics in the past 25 years which have approximately halved their numbers each time. This has resulted in an aftermath of a higher proportion of breeding females, and hence pups, in the population than normal (Reijnders et al., 2009), and half the surviving pups will become breeding females themselves after a 5–6 year time lag. Primiparous females are inexperienced mothers and, since birth weight is correlated with maternal mass and age (Bowen et al., 1994), it is likely that in the past decade there has been a ‘baby boom’, including many low birth-weight pups born to young females. This may be part of the explanation for the high incidence of low-weight ‘orphan’ pups found stranded. Average birth weight for healthy, non-stranded harbour seal pups is about 11kg (Bowen et al., 1994; Cottrell et al., 2002). Low birth weight is expected to reduce fitness for reasons including less physical development, reduced insulation, high body surface area relative to volume and therefore a high metabolic overhead in cold water (Colttmann et al., 1998). About half of stranded orphan pups recorded here were < 10kg weight (53% of pups at Friedrichskoog, 48% in Niedersachsen and 55% in Lincolnshire). If many of these underweight orphans are born to young females, it is possible the present high stranding rates may be a transient phenomenon which will pass when the breeding female population regains equilibrium with only a small percentage of primaparous females each season.

Another possible cause of low birth weight pups is poor nutrition of the mother during pregnancy, and this could be due to insufficient prey resources. This could happen if the population in the southern North Sea is now approaching its carrying capacity, and would contribute to population regulation. The apparently increasing numbers of post-weaning pups stranding in a starved condition and 3–6 month old pups stranding in a debilitated condition with lungworm might also indicate that the population may be reaching its carrying capacity.

It is possible that both factors – high numbers of primiparous are operating simultaneously. Because of the pattern of rapid population growth following the PDV epizootics, the population is having to come to terms with limits of the environmental carrying capacity suddenly rather than gradually.

It is also possible that disturbance from pedestrians and recreational boats could be contributing to healthy neonate pups being separated from their mothers (e.g. Osinga et al., 2012), although there is no direct evidence that actual separations due to disturbance are happening at the present time.

To rehab or not to rehab?
Any decision about whether or not to take an ‘orphan’, sick, starving or injured pup into the human environment needs to be taken in the context of what is understood about the population and according to national/regional directives, as well as fulfilling the natural human urge to help a young animal in distress.

In the Wash area at the present time this has not become a question for serious debate, probably because the numbers of stranded pups are relatively low (when compared to the Wadden Sea coastline) and there are a number of facilities able to care for them alongside their other activities Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
(two nature parks, one aquarium and one general wildlife hospital). In the Wadden Sea, by contrast, the numbers of harbour seal pups stranding annually is now approaching the thousand mark (Denmark, Germany and the Netherlands figures combined for years between 2007–12), which is ~15% of recorded pup production (TSEG, 2012). It clearly makes sense in this context to stand back and discuss whether rehabilitation and release should be attempted for all, some or none of these stranded pups.

Rehabilitation of ALL stranded pups every year – now approximately 1000 a year along the Wadden Sea – could result in a 15% increase in the present juvenile population and in the breeding population a few years hence. If the population is already struggling to come to terms with reaching its environmental carrying capacity too rapidly (due to imbalance in the population structure during the post-epizootic recovery period), increasing the juvenile population by 15% every year may actually conflict with the populations’ inherent self-regulation mechanism by increasing the number of young animals seeking food and the number of maturing females becoming pregnant, and could result in poorer survival of the next cohort of pups. Thus release from rehabilitation of this number of pups could become a self-perpetuating problem rather than a solution. It may be relevant to consider that large-scale rehabilitation of grey seal pups (now >150 per year at SSRC, Oisinga & ‘t Hart, 2012) could also be placing additional pressure on the environment’s carrying capacity for harbour seals. One participant raised the ethical concern of taking possibly threatened fish stocks to save pups that would normally be expected to die – where large numbers of pups are involved, this could become a significant concern.

The rehab centres in Lincolnshire and in Germany take pups only on a ‘passive’ basis, i.e. when an apparently distressed pup is encountered, usually by the general public, on the public shoreline, away from a seal haul-out site. At the present time only SSRC in the Netherlands is pro-active in entering seal reserves to look for pups believed to be stranded as well as searching for pups along the shoreline, and is the only Wadden Sea organisation to take all pups for rehabilitation. More than 200–300 harbour seal pups have passed through SRRC in some recent years, contributing to an annual total of 600+ now being rehabilitated annually in the Wadden Sea.

If large numbers of seals are being released back into the wild, it is necessary to know if their survival and behaviour post-release is normal, and therefore whether they are likely to develop into healthy adults with normal reproductive behaviour, including patterns of maternal care. This can only be assessed with a tracking device which records post-release dispersal, foraging patterns, dive times and depths and haul-out patterns in comparison with wild seals of comparable age from the same population. A few such studies have already been done (see separate workshop document on Evidence for success of rehabilitation), but these urgently need to be expanded, especially to areas where rehabilitation is practiced on a significant scale. Studies should distinguish between the different factors which may affect post-weaning survival and behaviour, such as the age and condition of pups at stranding, their environment and conditions at all stages during rehab, their time in rehab and their body condition and season of release.

Rehabilitation of SOME stranded pups every year – In Niedersachsen ~63% of all stranded pups have been admitted to rehabilitation in recent years, and Schleswig-Holstein adopts a similar practice

Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
(actual figures not available at present); all other pups found stranded are euthanized in situ by licensed hunters. The data presently available do not allow for an assessment of the criteria used to decide which pups should be euthanized and which should be brought to the rehab centre. Since the pups at Friedrichskoog (Schleswig-Holstein) are mostly ‘orphans’, it may be that post-weaning pups with injuries and lungworm infections in S-H are more likely to be euthanized in most years, but this has yet to be confirmed with the recorded data. A higher proportion of post-weaning pups in the rehab centre at Norddeich (Niedersachsen) may be due to a different organisation and structure of the stranding network in that state (J. Sundermeyer, pers. comm.).

If selective euthanasia and rehab is to be practiced in the future, we would request that the criteria for the decision should be clarified, and based on studies of the survival of pups in rehab to release with different stranding weights and conditions, as well as on local population status.

The survival of rehab pups to release may be assessed from analysis of detailed rehab records, such as are currently available from the Lincolnshire sanctuaries. These records seem to indicate that it is difficult to predict the outcome of rehabilitation attempt from initial condition, except in extreme cases of wounding, injury and infection such as herpes (or PDV). At the Lincolnshire centres, pup weight was not a predictor of rehab survival, although at Friedrichskoog the highest mortality during rehab seems to have been with very small-sized orphans. A clinical evaluation scoring system for harbour seal orphans was developed in the Marine Mammal Center in California, which involved evaluation of five factors (heart rate quality, respiratory rate, respiratory character, behavioural attitude and mucous membrane colour), with each factor receiving a subscore of 0–2 (the maximum total score therefore being 10). Pups that survived more than 28 days in rehabilitation had a significantly higher score (8.57) than pups surviving less than four days (6.64; Dierauf & Dougherty, 1983). The authors suggested that this ‘PUPGAR’ score might assist in determining the degree of intensive care necessary.

Some post-release tracking results (see separate document) have suggested that pups admitted to rehab at 3–5 months old may behave apparently normally post-release, while pups admitted as neonate ‘orphans’ may disperse more widely and have lower survival rates than their wild peers. Such results are far from definitive at present, and have not distinguished between orphan pups raised in different conditions. Nevertheless, if studies point to the relative post-release success for pups admitted at 3–5 months old (Morrison et al, 2010), this might affect decisions to euthanize such pups selectively at stranding.

One idea put to the workshop – which is relevant to selective rehabilitation – is that rehabilitation effort might seek specifically to redress direct anthropogenic impact on the population (such as pups orphaned due to human disturbance, seals entangled in fishing net, seals injured by vessel propellers, jet-ski collision injury, etc), while endeavouring not to interfere with natural population processes. Such consideration might be very feasible, with careful interpretation of the stranding condition, weight and season.

**NO rehabilitation for release.** This is the current practice in Denmark, and has been adopted for the reasons outlined in the 1994 Leeuwarden Declaration, i.e. concerns of returning significant numbers of pups to the wild after a period in the human environment. Wildlife rangers assess the condition of Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
any stranded pup encountered and either euthanize it in situ (by shooting) or decide on no intervention. Stranded pups are occasionally taken into permanent captivity for research or aquaria. The percent of pups estimated ≤1 year euthanized is in the region of 47–70% of the total found stranded (60–130 per year 2007–10), with highest percentage during the June-July pupping period. However, the criteria for deciding between euthanasia and ‘no intervention’ are not known. The fate of stranded pups left alone is also not known.

**Recommendations**

We conclude from the workshop proceeds and contributed data that more research and greater cooperation between different seal centres and regional institutions is needed if the best possible decisions are going to be taken on the part of individual seals and populations in the future. The following suggestions and recommendations are made as a result of the workshop discussions and analysis of data given by workshop participants.

1. A definition of ‘stranded seal pup’ should be agreed and guidelines for identifying stranded harbour seal pups should be developed. Such guidelines would be specific to harbour seals but would be based on general principles which could also be applied to other seal species. Guidelines for harbour seals are currently being drafted as part of the Suzdal workshop output.

2. Where rehabilitation is practiced, pro-active searching for stranded pups should not involve actual seal breeding or haul-out sites while seals are present. (This is not, in any case, permitted in Germany). Venturing into active haul-out sites causes disturbance and may result in mother-pup separation. Moreover, a pup temporarily without its mother in attendance may be mistaken for an orphan (see draft guidelines on identifying stranded harbour seal pups).

3. Harbour seal rehabilitation practices should be consistent with up-to-date research on population, reproductive and developmental biology, and should always be compatible with regional management and conservation aims and practices. Any new rehab centres should be developed in consultation with the responsible authorities, as is already the case in Germany.

4. In regions where some stranded pups are euthanized and others are brought to rehabilitation, we would request that criteria should be clarified or developed for deciding which outcome should be followed in individual cases. These criteria should ideally be based on the numbers of stranded pups, knowledge of the population status and levels of human impact, as well as the known outcome of rehabilitation success of pups stranding at different ages and conditions.

5. In regions where stranded pups must either be euthanized or left with no intervention, we would request that criteria be clarified or developed for deciding which outcome should be followed in individual cases. A study should be developed to tag, mark or otherwise follow seals which are not euthanized so as to determine their fate and hence the appropriateness of the decision not to intervene. The aim of the study would be to determine conditions

Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
indicative of potential viability while at the same time reducing the suffering of those animals in distress and possibly on a shoreline frequented by people and dogs. Possibly Denmark might re-consider the possibility of rehabilitation of small numbers of pups which are thought to have stranded most probably due to human disturbance or other impact rather than due to natural causes.

6. Post-release studies using satellite or GPS telemetry should be carried out in areas where large-scale rehabilitation is practiced in order to determine the outcome according to stranding age and condition as well as rehabilitation conditions, procedures and duration.

7. It is suggested that a project be developed together with the Wadden Sea TSEG where participating centres would keep detailed records of all stranded pups in a standard format to facilitate analysis with updating – excel is suggested. Data should ideally include stranding date, location (GPS where possible), observed condition, weight, standard body length (straight length nose to tip of tail) of dead pups, date of death in rehab, weight and post-mortem diagnosis if available, date and GPS location of release, weight at release, tag number/colour and any post-release tracking. Electronic (low resolution) photos showing the condition in situ or immediately on entering rehab could be helpful in some cases of sick or injured pups. These data could be held and periodically analysed by TSEG in conjunction with other participating organisation. There is currently no organisation in the UK which collates UK seal stranding and rehab data, and this could therefore be initiated.

8. If desired the stranding and rehabilitation data network could eventually be extended to include the coastlines of Belgium, France, Ireland and all of the UK.

9. This model for a harbour seal database and stranding guidelines could later be extended to other seal species, with the grey seal probably next in line.
References


Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
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Stranding data from 2002–11 were contributed by Natureland (Skegness) and Mablethorpe seal sanctuaries on the Lincolnshire coast just north of the Wash.

As is evident from Fig. 1, the main distribution of pups is along the inner Wash shore. Pups taken in by the Natureland and Mablethorpe are those stranding along the Lincolnshire mainland shore, mainly between Gibraltar Point (the most north-westerly point of the Wash, just south of Skegness) and Mablethorpe. There are no seal haul-outs along this shore, and all pups entering these sanctuaries have stranded on beaches or coastline used by the public. All live-stranded pups since 2003 are accepted for attempted rehabilitation, and euthanasia is not generally practiced. Data contributed by Natureland and Mablethorpe have included date and location of stranding, sex, weight and description of condition of pup, and date and weight of release (or death, if the pup did not survive to release). Data from both sanctuaries have been combined to produce an overall picture for this stretch of coast.
The annual total number of harbor seal pups received by both sanctuaries increased from ~20 to ~60 between 2003–06 and then remained fairly steady at ~40–55 pups up to 2011 (Fig. A2).

Total numbers of pups stranding in Lincolnshire have therefore remained fairly constant while the number of pups born in the Wash has been increasing. The number of pups stranding in Lincolnshire as a percentage of total pups has actually decreased since 2005 (Fig. A3).

The seasonal distribution of stranded pups was highest in Aug-Sep, followed by Oct-Jan, then the Jun-July pupping season, and fewest in Feb-May (Fig. A4). Although there have been a few neonatal pups stranding in the pupping season, the majority have therefore been post-weaning pups form 2–6 months old which have dispersed away from their natal sites within the Wash to prospective foraging grounds, but have not successfully made the transition to independent feeding. There have been very few pups older than 6 months stranding along this coast. There has been a slight bias towards Natureland in Skegness receiving more neonatal pups (64:24 N’land:M’thorpe), with

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numbers of older pups being generally similar in both sanctuaries. This is undoubtedly because Skegness is closer to the breeding colonies in the Wash (Fig. A1).

![Graph showing seasonal distribution of pup strandings along the Lincolnshire coast.](image)

**Fig. A4.** Seasonal distribution of pup strandings along the Lincolnshire coast

The average weight of stranded pups has gradually increased throughout the year, averaging just under 10kg for neonatal pups, to 13 kg in Aug-Sept, to 18 kg in Oct-Jan and 22 kg in Feb-May (Fig. A5).

![Graph showing increase in average weight of stranded pups from pupping season to the following spring.](image)

**Fig. A5.** Increase in average weight of stranded pups from pupping season to the following spring

Assuming average weaning weight is ~24kg and average loss of ~20% body mass before the pup learns to feed effectively during the first post-weaning month, average body mass should be ~19kg. The average of these stranded pups is therefore much lower than that of a healthy pup successfully learning to forage. Harding et al (2005) found that the probability of surviving the winter was positively correlated with the pups’ weight in late autumn – they estimated that pups in the Baltic of 17kg weight on October 1st had only a 0.63 chance of surviving the winter, while a pup of 32kg had a 0.96 chance.

Stranded pups with no visible injury or condition were in the minority, and were commonest in the pupping season, i.e. these were mostly pups which had become separated from their mother at or soon after birth. Mouth, muzzle or jaw infections or bleeding were the most frequent conditions

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described, and this condition was most prevalent in Aug-Sep and slightly less so in Oct-Jan. Other wounds (which included bleeding around the hind-flippers possibly from the anus, and also secondary injuries such as dog bites) were frequent in Aug-Sep and Oct-Jan. Lungworm (or suspected lungworm due to coughing and respiratory difficulties) was first seen in Aug-Sep, but was most frequent later in the season, Oct-Jan (Fig. A6).

The number of pups dying during rehabilitation ranged from 10% in Feb-May, to 20% in June-July, to 33% in Aug-Sep (Fig. A7). However, the pups that died had similar average weights to pups who survived to weaning (Fig. A8).
Fig. A8. The stranding weight of pups that died during rehab as a % of total pups in rehab (left) and compared with average weight of all pups in the same season (right).

Additional reference

APPENDIX B

**DENMARK**

Stranding data for 808 seals between 2003–10 in Denmark was collected from the Wadden Sea area of the Danish coast (Fig. B1) by the Danish Nature Agency, the Fisheries and Maritime Museum and the National Veterinary Institute. Data were contributed to the workshop in tabular format giving date and location of the stranding, whether the seal was found dead, was euthanized in situ (shot by rangers), or where there was no intervention (seals have not been taken for rehabilitation in Denmark during this study period). Where available, a measure of body length of the seal was given (34% of 808 records) and body weight were also recorded in 24% of 335 records up to 2007. A presentation was also contributed with data provided from post-mortems performed on euthanized animals from 2008 (n=153) at the National Veterinary Institute.

![Fig. B1. Area of reporting harbour seal strandings in Denmark 2003–10](image)

SCS divided the Danish data into seals reported with body length >120cm (assumed to be seals > 1 year or adults) and seals with body length up to 120cm or no measurement (assumed to be pups or yearlings). The total number of live-stranded seals < 120cm reported in Denmark increased approximately in relation to the increasing number of pups recorded for Denmark during this period, though there were considerable fluctuations (Fig. B2) and the correlation between the total pup count and the percent of live-stranded seals for 2003–10 was only 0.61 (P>0.05; two-tailed test).
The number of live-strandings of seals assumed to be ≤ 1 year was greatest in Oct-Jan, followed by the June-July pupping season, but with significant numbers also stranding in the post-pupping season (Aug-Sep) and the spring (Feb-May) (Fig. B3).

Fig. B2. Number of live-stranded harbour seal pups (≤120cm where measured) as a percentage of total pup count in Danish Wadden Sea. Difference between % live-stranded and % euthanised is number for which ‘no intervention’ recorded.

Fig. B3. Seasonal distribution of live-stranded harbour seals in Denmark (≤120cm where measured).

However, the Danish analysis of the annual breakdown of seasonal strandings (contributed to the workshop) suggested considerable annual variation in stranding seasonality, eg most strandings in May-July in 2003, but in Sep-Oct in 2004, more in the first half of the year in 2005, but in the last half in 2006, relatively evenly distributed in 2007, and mostly in the last half of the year in 2008-10.

Post-mortems of sead-stranded seals indicated a possible increase in lungworm up to 2006 and a steady proportion of animals (~70%) since then. Stomach nematodes have appeared in 40–50% seals in most years (fewer in 2006, more in 2005) and heartworm seemed to be most prevalent in 2006 >55%) but to decline thereafter to zero in 2010.
APPENDIX C

GERMANY - Schleswig-Holstein and Niedersachsen (Lower Saxony)

The Friedrichskoog seal sanctuary in Schleswig-Holstein (Fig. C1) contributed data from 2003–12 on all harbour seal pups entering the rehabilitation centre. The data include the date, location, sex and weight of the stranded seal pup, death during rehabilitation or successful release, and the weight and date of release. Stranded seals in Schleswig-Holstein considered to be too badly injured or ill to be rehabilitated were euthanized in situ by game-wardens during this period, and data on these euthanized seals were not available at the time of the workshop (although we hope to include these in the analyses in the future).

The seal sanctuary at Norddeich in Niedersachsen (Fig. C1) was able to contribute data for 2009–11 as submitted to the TSEG in annual reports. These data include all stranded seals recorded, the date and location, sex, estimated age (in days) and weight, whether euthanized (or died) or rehabilitated successfully to release.

Fig. C1. The Schleswig-Holstein and Niedersachsen areas of the Wadden Sea coastline

The total number of harbour seal pups admitted to Friedrichskoog has gradually increased since 2006 to just over 160 in 2012. However the percentage of pups as a percentage of the total pup counts in Schleswig-Holstein has remained around 3–4% (Fig. C2).

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For Niedersachsen, the total recorded strandings have increased from 174 and 181 in 2009 and 2010 (12% and 11% respectively of the total pup count for Niedersachsen) to 271 in 2011 (17% of the total pup count). The % stranded pups successfully rehabilitated to release has varied only between ~60–68% between 2009 and 2011. The number of rehabilitated pups as a percentage of the total pup count in Niedersachsen, at between ~6–10%, has been greater than in Schleswig-Holstein (Fig. C3).

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The number of harbour seals admitted for rehab by season has differed in these two parts of the German coastline. Almost all pups admitted to Friedrichskoog (Schleswig-Holstein) have been newborn pups in June-July (with also a few early pups in May). The greatest numbers of pups admitted to Norddeich (Niedersachsen) have also been in June-July, but with significant numbers also later in the season, especially October to January (Fig. C4). It is possible that pups found stranded later in the season in Schleswig-Holstein are euthanized by game wardens.

Fig. C4. Percentage of total rehab pups admitted by season in Schleswig-Holstein and Niedersachsen

Most pups entering Friedrichskoog were at or less than average birth weight (~11 kg). Only ~2% were pups weighing 14kg or more. By contrast, more than 30% of pups entering rehabilitation at Norddeich were 14–24 kg (Fig. C5). In Niedersachsen the number of pups rehabilitated compared to the number euthanised was greatest in June-July, i.e. mainly post-natal ‘orphans’. The number of ‘orphans’ euthanised was greatest in the smallest category and declined with pups up to 13 kg (Fig. C6).
Fig. C5. Number and percentage of stranded pups entering rehab at each weight at Friedrishskoog and Norddeich centres.
The pattern of pups euthanized or dying in rehabilitation has been similar in both Schleswig-Holstein and Niedersachsen – the largest number of pups dying or being euthanized has been the smallest pups (6–7 kg), followed by pups 8–10 kg, i.e. also less than average birth weight. However, nearly 40% of pups 12kg or more were euthanized in Norddeich. The total figures for pups euthanized in situ in Schleswig-Holstein are not available at present (Fig. C7).

Fig. C6. No. euthanised and rehabilitated pups – Norddeich 2009–11
APPENDIX D

NETHERLANDS

No data on pup stranding and rehabilitation were available from Netherlands seal sanctuaries at the present time. Reijnders (2009) reported a total of 792 pups taken for rehabilitation in the Netherlands between 2000–05, and estimated that number to be ~15% of pup production in the Netherlands during that period. Approximate figures up to 2007–08 for the number of common seal pups at one of two rehabilitation centres (SSRC) in the Netherlands (Osinga & ′t Hart, 2010) suggest that 9–20% of the total pups born in the Netherlands were passing through that centre (Fig. D1).

During 2011–12 there were ~350 common seal pups reported at SSRC, which represents ~24% of the pups born in the Netherlands that year. In addition there were ~80 pups rehabilitated at the Ecomare centre in the northern Netherlands, making a total of about 30% of pups in the Netherlands Seal pup stranding and rehabilitation workshop, MMH Suzdal, Sept 24 2012.
passing through rehabilitation. Of 92 pups estimated ≤ 1 year old, dead-stranded between 1997 and 2008, 22% died of starvation (half of these in June-July) and 12% of parasitic pneumonia (lungworms *Otostrongylus* or *Parafilaroides*). Lungworm cases were most frequent in autumn-winter (Osinga et al., 2012).

**Additional references**
