Vol. 10, No. 3

WILDLIFE JOURNAL

Journal of the International Wildlife Rehabilitation Council

Sample



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2. Full length articles run between 1500 and 2500 words.
3. Fillers and short articles run between 500 and 1500 words.
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EDITORIAL . . .

Offsetting Man's Impacts

With renewed interest in offshore oil drilling in California, the threat of oil spills are ever present. While rehabilitators have been dealing with oil contaminated birds for some 20 years, the last two California oil spills (Puerto Rican '84 and Apex Houston '86), have netted much new information. We have dedicated this *Wildlife Journal* to a collection of papers reporting on this information by a diverse team of scientists, rehabilitators, veterinarians, and field biologists.

Thanks to the efforts of the staff and volunteers at the Point Reyes Bird Observatory (PRBO) in Bolinas, California, we have a quantified summary of the birds involved in the Apex Houston spill. This 1986 spill involved a relatively small amount of oil but a large number of birds were affected (approximately 11,000) with over 3,300 live birds presented for washing. Additionally, their work on the oil slick trajectories were instrumental in locating the responsible parties. PRBO also estimated birds lost at sea, figures that were quite useful to the California Department of Fish and Game and Coast Guard in damage assessment and penalty determination.

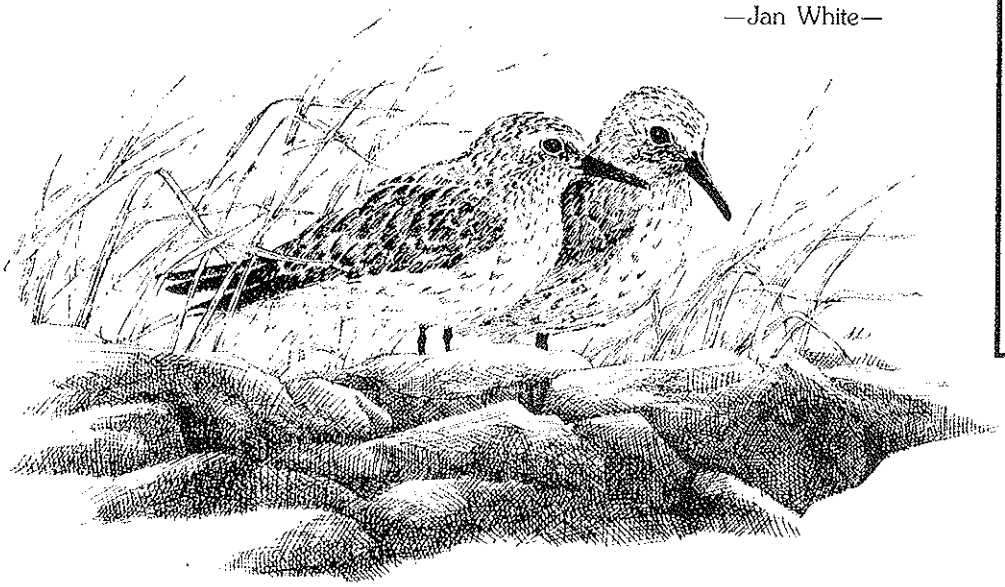
Among the information published in this issue are the clinical pathology values of birds contaminated with of Bunker C. fuel. Not all fuels will cause hemolytic anemias which accounts for the fact that eastern rehabilitators have not seen the kinds of blood values reported here. It seems that Pennsylvania oils are cleaner.

Many of the species affected by oil spills are also those species that dive as a normal feeding behavior. Hemolytic anemia caused by oil ingestion renders these birds unable to dive and hunt for food once they are cleaned and waterproofed. Recovery from the red blood cell destruction requires a month or longer of good supportive care with excellent nutrition. While we always wanted to clean the birds as quickly as possible, we now must find a way of reducing ingestion and other exposures to this oil on an immediate basis.

With this knowledge, an even greater emphasis will be placed on capturing the affected birds and transporting them to the cleaning center. We will develop what ever methods possible to minimize the exposure of the birds to the oil. We have to monitor and carefully evaluate cleaned birds prior to release. Along with normal requirements that must be met before release, we now need to check the blood values which are so indicative of the ability to hunt and dive.

A great deal of research remains a head of us to solve the problems in oiled bird rehabilitation—at least now we know what we are up against. We also have enlisted the assistance of various interested professionals to help us work on it. Together we will try to offset man's impact on the wildlife around us—as we always have.

—Jan White—



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Hemolytic Anemia Complicates The Cleaning of Oiled Seabirds

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INTRODUCTION

Two major oil tanker spills in central California in 1984 and 1986 resulted in the oil fouling and loss of many thousands of seabirds. As a consequence of these spills we were able to work with many oiled birds to evaluate the toxic effects of oil and the complications in rehabilitation and release of cleaned birds. This report is an update and analysis of oil toxicity and not a completed set of recommendations for treatment and rehabilitation of oiled birds, as we are continuing to unravel the causes and effects of the anemia and secondary problems suffered by oiled seabirds.

The first recent spill occured when the tanker "Puerto Rican" exploded and burned in the ship channel outside the Golden Gate on October 31, 1984. The ship broke up four days later with the stern section sinking south of the Farallon Islands just outside the Gulf of the Farallones Marine Sanctuary and spilling approximately 1.5 million gallons of several types of petroleum products. Several thousand oiled birds were recovered, largely through the efforts of hundreds of volunteers. Most birds were cleaned and rehabilitated at a temporary facility at Fort Cronkhite on the Marin Headlands, and several hundred birds were transferred to other rehabilitation facilities throughout the San Francisco Bay Area.

The second major oil spill occured in early February 1986, when the oil barge "Apex Houston" lost about 20,000 gallons of San Joaquin Valley crude oil while under tow from San Francisco to Long Beach. A relatively small amount of oil was lost, but the spill occured off the central California coast in the winter feeding areas of Common Murres (*Uria aalge*), Rhinoceros Auklets(*Cerorhinca monocerta*), Western Grebes (*Aechmophorus perspicillata*), loons and sea ducks. Page and Carter (1986) estimated that more than 10,000 birds became oiled. Large emergency cleaning centers were established at Alviso and Moss Landing and all available facilities of Humane Society shelters and wildlife care centers in the S. F. Bay and Monterey areas were mobilized.

STUDIES OF ANEMIA

Throughout the course of the "Puerto Rican" recovery effort, we took blood samples from a few dozen oiled murres to study the toxic effects of oil ingested when birds preened. We measured the hematocrit (packed cell volume, PCV) and plasma total protein level, made blood smears for light and electron microscopy, and took oil samples for residue analysis. All birds examined were oiled with Bunker C fuel oil or with mixtures of Bunker C and the other oils carried as cargo. Most of the birds had hematocrits of 40% to 20%, indicating mild to severe anemia with 25-60% loss of circulating red blood cells (the normal hematocrit of Common Murres is 50-55%) (Bradley and Threlfall 1974)).

Dried blood smears of oiled murres were examined by scanning electron microscopy (SEM) and compared with smears from unoiled murres, Cassin's Auklets (*Ptychoramphus aleuticus*) and chickens. The normal red blood cells of murres (Figure 1) were ovate and smooth-surfaced, occasionally showing a slight indentation over the nucleus, but many cells from oiled, anemic birds contained clumped aggregates of hemoglobin (Heinz bodies) which were visible beneath the cell membrane after air drying (Figure 2). The Heinz bodies of murres were smaller than those in mammalian erythrocytes (Jain and Keeton, 197X), but very similar to petroleum-induced Heinz bodies from other species of birds (Leighton et al. 1983, Leighton 1985).

The small blood sampling effort following the "Puerto Rican" spill illustrated the severity of the toxic anemia, but created many more questions than answers. The "Apex Houston" spill provided a second opportunity to survey many birds and make a better evaluation of the criteria to be used in cleaning and release of oiled seabirds.

During the weeks of cleaning effort following the "Apex Houston" spill, Jan White (previous IWRC President and a veterinary student at UC Davis) organized several teams of veterinary students to draw blood and determine the extent of hemolytic anemia suffered by birds as a result of ingesting oil. Over the course of four weeks, the hematocrit and total plasma protein levels were examined from 632 birds housed at several cleaning centers. Additionally, several Common Murres rehabilitated at the Monterey SPCA were sampled repeatedly by Dr. Gary Brake (Crossroads Veterinary Clinic) and Dr. Michael Murray (Coast Veterinary Hospital) to evaluate their recovery.

Table 1 gives the species composition, numbers, and average blood values of birds monitored during February and March 1986. Figure 3 shows the PCV profile for 580 Commn Murres. The average hematocrit was 37.7% (approximately 25-30% reduction in red cells), but with much variation between birds. Some birds had hematocrits below

10%, representing an 80% loss of total red blood cells.

The blood values from oiled birds kept at the Alviso cleaning center are given in Figure 4. Because of the high numbers of oiled birds, several weeks were required to clean all of them, and the values given in Figure 4 are for birds which had not yet been cleaned. The hematocrits of unwashed birds did not begin to recover as long as the birds were able to preen and ingest oil.

Drs. Brake and Murray, with the cooperation of the Monterey SPCA, monitored the progress of 9 murres after they had been cleaned. Four of these birds were severely anemic at admission (with hematocrits less than 30%) and their regenerative progress is shown in Figure 5. The figure is striking in that the anemia was corrected only very slowly, requiring 30 days to return to 90% of normal from a hematocrit of 20%.

All nine murres had elevated plasma total protein levels (above 5.0 gm/dl), values initially interpreted as indications of dehydration. Rehydration therapy did not reverse the high plasma protein values, and the total protein levels remained high for more than 4 weeks of captivity. A commercial laboratory (Veterinary Reference Labs., San Leandro, CA) made a preliminary estimation of albumin and globulin levels which indicated very high globulins without corresponding increases in serum albumins, a finding not consistent with simple dehydration. We received the cooperation of Dr. J. Zinkl at UC Davis in conducting plasma protein electrophoresis to quantify serum proteins.

Figure 6 compares the plasma protein profiles of one oiled bird kept four weeks in captivity with one of six wild Common Murre blood samples obtained by Dr. Don Croll on Southeast Farallon I. in May, 1986. The wild bird had a serum protein profile typical of other species of birds, with a distinct prealbumin region (PA), a prominent albumin peak (Alb), and lower levels of alpha (A), beta (b) and gamma (G) proteins. All six wild murres had similar protein profiles, with small variations in the levels of gamma globulins. The oiled murres, however, all lacked the prealbumin peak and had variable, marked elevations of alpha, beta and gamma proteins.

While no serum protein studies have been conducted with murres, the similarities between serum proteins in other birds and mammals (Doolittle 1984, Sottrup-Jensen 1987) can allow conclusions to be drawn as to the functional significance of changes in murre serum proteins. Liver toxicity and poor protein nutrition both have been implicated in reduced prealbumin and albumin synthesis (Moskowitz et al. 1983, Hutchinson et al. 1981). This might be expected with oiled birds as liver cell disassociation and abnormal iron storage occur in oiled birds (Fry and Lowenstine 1985), and adequate nutrition is a chronic problem with captive seabirds. An equally possible, and more attractive, explanation is that prealbumin systhesis was suppressed as part of the regulation of the plasma protein concentration to compensate for the increased synthesis of other plasma proteins which occurred in response to inflammation and infection (Schreiber 1987).

The increases in plasma alpha, beta, and gamma proteins which occurred in the oiled murres appear to indicate a strong reaction to acute inflammation and a well developed immunoglobulin response to infection. Many of the alpha and beta proteins have been identified in mammals and birds as "acute-phase proteins", a diverse group of plasma proteins which become elevated in response to inflammation (Putnam 1984, Schreiber 1987). Several acute-phase proteins are protease inhibitors which protect against the systemic release of intracellular proteolytic and lysosomal enzymes after tissue damage. Other acute-phase proteins include hemopexin and haptoglobin, iron- and hemoglobin-scavenging proteins which help conserve and recycle iron during a hemolytic crisis.

The impressive magnitude of the acute phase and immunoglobulin responses indicate that the murres were capable of sustaining a defense against the toxic effects of the oil and the secondary infections even while under the stress of captivity and forced feedings. These tough birds appear to be functioning very well in captivity and murres are probably good candidates for successful rehabilitation.

The high serum protein pattern at 30 days and the lack of any response to attempted rehydration appears to indicate that the initial elevation in total plasma proteins represented

TABLE 1

SPECIES COMPOSITION AND AVERAGE BLOOD VALUES OF OILED BIRDS EXAMINED AFTER THE 1986 "APEX HOUSTON" SPILL.

SPECIES	NUMBER	HEMATOCRIT		TOTAL PLASMA PROTEIN	
		% ± SEM	RANGE	X ± SEM	RANGE
COMMON MURRE (Uria aalge)	580	37.7 ± 0.4	9-73	5.1 ± 0.1	0.6-8.5
ARCTIC LOON (Gavia arctica)	16	32.9 ± 1.1	20-39	4.4 ± 0.2	2.8-5.8
RED-THROATED LOON (Gavia stellata)	1	21		1.3	
COMMON LOON (Gavia immer)	3	39 ± 0.5	30-40	3.2 ± 0.7	1.7-4.7
SURF SCOTER (Melanitta perspicillata)	6	36.2 ± 2.8	25-43	4.9 ± 0.2	4.0-5.5
WESTERN GREBE (Aechmophorus occidentalis)	25	37.5 ± 1.4	21-51	4.2 ± 0.2	1.8-6.2

a rapid and marked acute response to inflammation after oil ingestion. The longer-term sustained elevation of immunoglobulins may very well have been a secondary response to pathologic agents acquired during captivity, such as *Aspergillus* infections of the respiratory system and bacterial infiltration of epidermal and joint lesions of the legs and feet which were common to most murres kept in captivity for long periods.

The very slow recovery from anemia is disturbing, however, as most bird species normally have a rapid, strong regenerative response to anemia. Although a complete evaluation of the blood smears has not been undertaken, two possibilities could have contributed to the slow recovery: There may have been a regenerative response, but accompanied by prolonged hemolytic anemia due to toxic petroleum residues in the birds; alternatively, the regenerative response could have been reduced because of toxicity to the kidneys or blood forming tissues. Kidney toxicity with tubular degeneration occurs in oiled murres (Fry and Lowenstine 1985) and could contribute to a diminished regenerative response because the primary hormone regulating blood formation, erythropoietin, is produced in the kidney (Antoniades, 1977).

The slow recovery from anemia was particularly unfortunate because of the secondary complications from aspergillosis, foot and hock lesions, and skin lesions over the keels in grebes and loons. Before any satisfactory long-term therapy can be seriously considered for large numbers of seabirds, improved care conditions need to be discovered to prevent these physical injury and respiratory problems.

SUMMARY AND RECOMMENDATIONS FOR CARE OF OILED SEABIRDS

The discovery of severe anemia arising from the ingestion of oil puts an additional complicating factor into the formula for cleaning and release of oiled birds. Diving seabirds probably cannot dive and forage for fish when their blood supply is severely reduced, but we have little data to predict the minimum adequate hematocrit values needed for survival. A small amount of data from released and re-beached birds following the "Apex Houstin" spill seems to indicate that birds with hematocrits less than 40% came back to beaches soon after release. These birds probably could not hunt well enough to sustain themselves. We recommend that murres should not be released until their hematocrits are 40% or above.

The hematocrit and total plasma protein levels can be evaluated quickly if the right equipment is available. A hematocrit centrifuge is required, and a hand-held optical refractometer can be quickly used to estimate total proteins. Only a few drops of blood from the metatarsal or brachial vein are required to fill a microhematocrit tube for a PCV measurement, and the plasma above the separated cells is sufficient for an estimate of total plasma proteins.

Hematocrits and plasma total proteins should be taken and recorded for each bird at admission. Birds with the highest hematocrits should be cleaned first and released very quickly, hopefully within 24-36 hours. Since recovery is slow and generally requires a very long time for severely anemic birds, most of these birds will eventually suffer from lethal secondary complications under the minimal care conditions available today at overcrowded cleaning centers. It is truly unfortunate, but if the cleaning and rehabilitation facilities are at maximal or above capacity, it would be most humane to euthanize birds with hematocrits of less than 25% at admission. These birds would require more care than available, and are high risk cases for secondary infections. Birds with very low total plasma proteins (less than 2.0 gm/dl) also are very unlikely to survive, and should be euthanized under these circumstances. We have shown above that high total proteins may not be indicators of dehydration, but may instead be indicators of a vigorous struggle for survival. Extra fluids will not harm the birds, so rehydration is preferable for any possibly dehydrated bird.

Birds should be prevented from preening, if possible, but we have not seen an acceptable method to stop them to date. Perhaps stockingette pullovers could be fashioned which would not be so tight that breathing would be

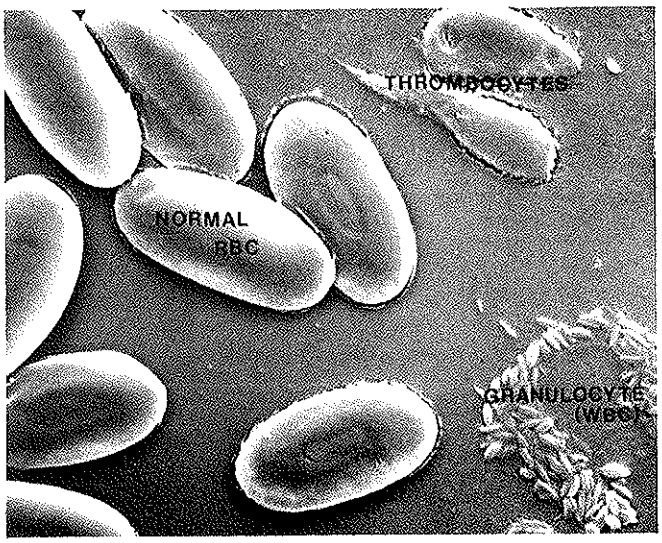


Figure 1. Scanning electron micrograph of air-dried blood cells from a Common Murre. Three cell types are shown: erythrocytes, thrombocytes, and a granulocyte.

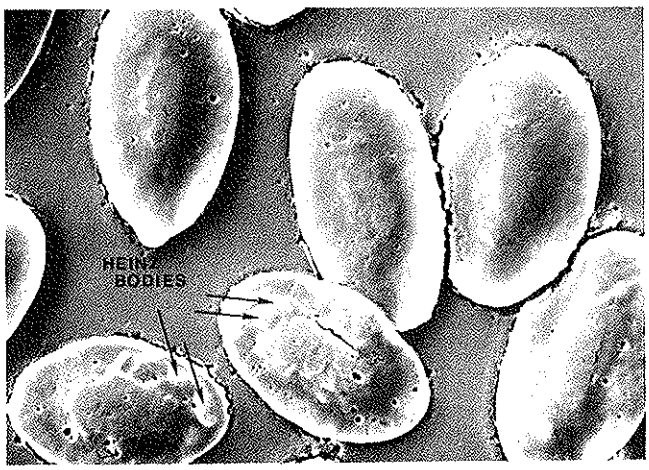


Figure 2. Scanning electron micrograph of air-dried blood cells from a Common Murre fouled with Bunker C fuel oil. Heinz Bodies composed of aggregated old hemoglobin are visible in the cytoplasm surrounding the nuclei of the erythrocytes.

restricted.

Birds brought to cleaing centers should be cleaned as soon as possible. This seems obvious, but after a large spill many birds have been kept for two weeks or more before being cleaned. We recommend that no cleaning facility accept birds that cannot be washed and waterproofed within 5-7 days. Keeping oiled birds longer may exacerbate the anemia and lengthen the recovery period necessary to restore hematocrits to 40%. Since long periods in captivity usually lead to lethal secondary complications, rapid cleaning and release is of paramount importance.

Aspergillosis and secondary physical lesions are the greatest impediments to successful long-term rehabilitation and release of oiled seabirds. If birds can be cleaned, waterproofed and released within 24-36 hours, aspergillosis and physical lesions are not unusually severe complications. Anemia, therefore, should become a critical index in evaluation of birds at admission.

As a conclusion, it is particularly important to evaluate and clean as many good candidates as possible, and not jeopardize the survival of all the birds by overloaded limited facilities in an attempt to save birds which will require extensive long-term care with little hope of successful release.

If only a few birds have been oiled and the available facilities have not been overloaded, by all means keep all birds, especially murres, and rehabilitate them until they can be successfully released.

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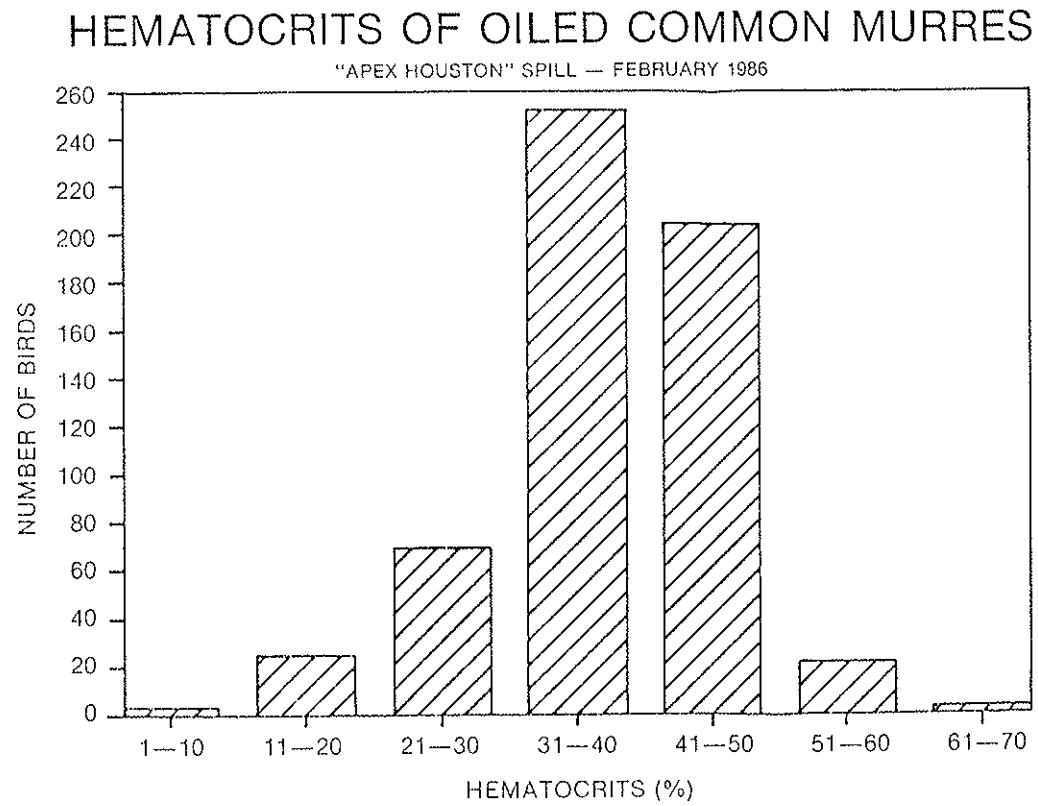


Figure 3. Histogram of the hematocrit values of 580 Common Murres oiled in the "Apex Houston" spill of February 1986.

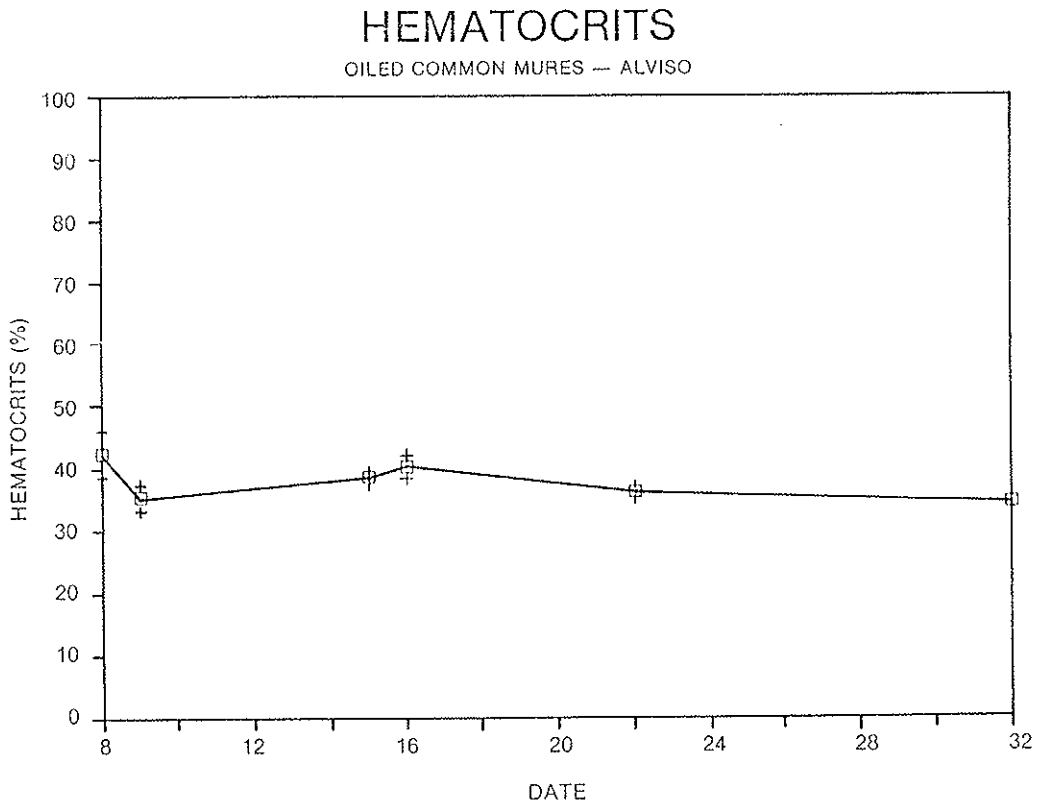


Figure 4. Hematocrit values (average ± SEM) of Common Murres oiled in the 1986 "Apex Houston" spill. Values are for birds kept in captivity for 8-32 days prior to removing oil.

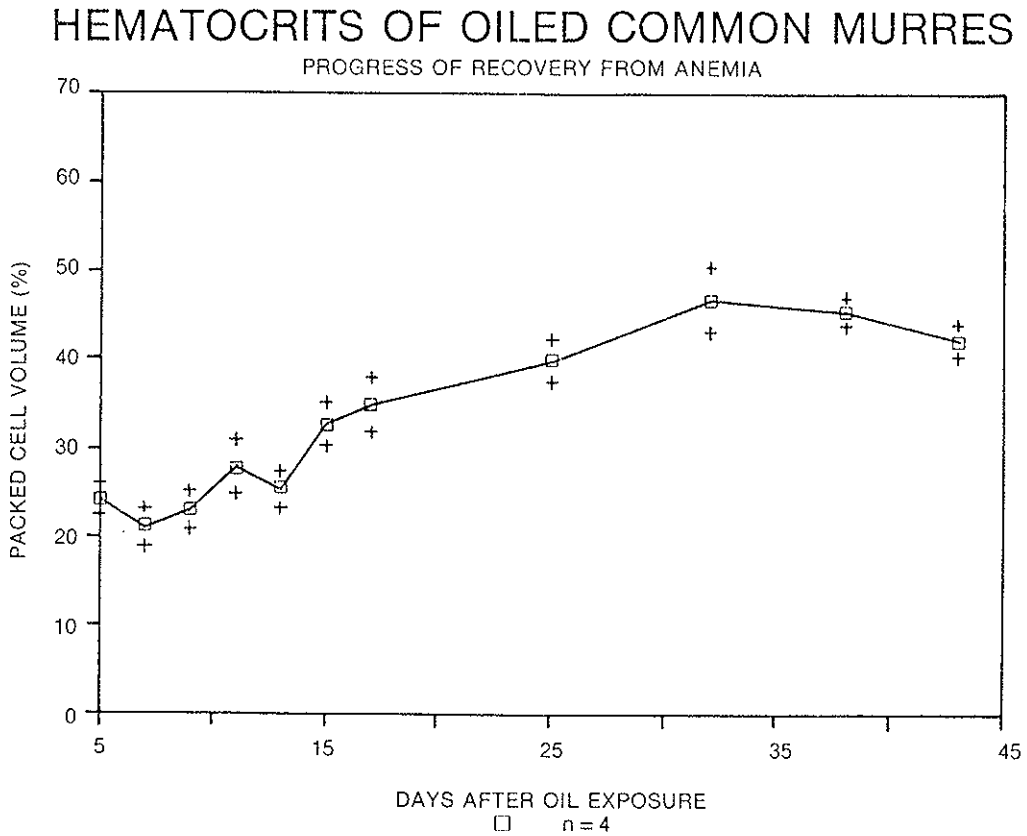


Figure 5. Recovery from hemolytic anemia in four Common Murres exposed to San Joaquin Valley crude oil in the 1986 "Apex Houston" spill and maintained in captivity at the Monterey SPCA for 45 days. Values are Averages ± SEM.

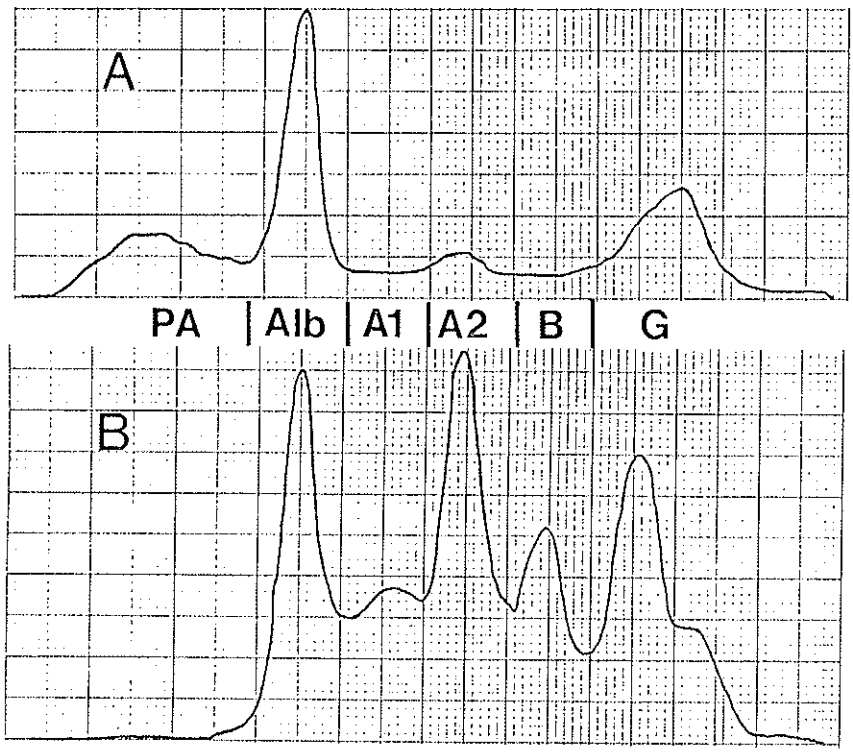


Figure 6. Optical density tracings of a cellulose acetate electrophoretograms of the plasma proteins of two Common Murres. A: Normal pattern from a murre from Southeast Farallon I. sampled May 1986. Regions of electrophoretic mobility are identified as: prealbumin (PA), albumin (Alb), alpha (A1 and A2), beta (B), and gamma (G) proteins. B. Pattern from a murre oiled in the 1986 "Apex Houston" spill and maintained in captivity at the Monterey SPCA for 30 days. Note the very high levels of alpha-1, alpha-2, beta and gamma proteins and the absence of a prealbumin peak.

The Importance of Rehabilitation Center Data in Determining the Impacts of the 1986 Oil Spill on Marine Birds in Central California

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Stinson Beach, CA

R. Glenn Ford
Ecological Consulting
Portland, OR

INTRODUCTION

During February 1986, a spill of *San Joaquin Valley Crude (SJVC)* oil injured wildlife along the central California coast. The California Regional Water Quality Control Board concluded that the oil was probably spilled by the tank barge *Apex Houston* while enroute from Martinez to Long Beach, California. An oil trajectory model indicated that if oil had been spilled along the route of the *Apex Houston* on 29 and 30 January 1986, it would have beached where it was observed during the incident (Fig. 1) (Ford et al. 1987). To assess the damage of this spill on seabird populations in central California, we used a method to estimate the total numbers of each species affected for three categories of impact (Page and Carter 1986, Ford et al. 1987). We estimated the numbers of live oiled birds that reached shore by tabulating records kept by rehabilitation, collection, and temporary-holding centers; we estimated the numbers of dead oil birds that washed ashore from carcass counts on beaches; and we estimated the numbers of dead oiled birds that were lost at sea through the use of a computer model. Rehabilitation center data proved to be instrumental for determiing the overall impact of the *SJVC* spill on seabird populations.

LIVE OILED BIRDS ON BEACHES

Live oiled birds were recovered from beaches and sent to rehabilitation centers through a large-scale rescue effort by government agencies, private organizations and concerned individuals. From data recorded at eight rehabilitation and collection centers (Table 1), we determined that the peak occurrance of live oiled bird beachlings was between 1 and 8 February (Fig. 2) and the main areas were between Salmon Creek, Sonoma County, and Point Lobos, Monterey County. We divided the central coast into six segments to examine variation in timing of beachings between segments. Most birds were recovered between the Golden Gate and Piegon Point, and in Monterey Bay (Fig. 3). Peak numbers occurred on 3 February north of Pillar Point and on 4-6 February south of Pillar Point (Fig. 3).

DEAD OILED BIRDS ON BEACHES

The staff and volunteers of Point Reyes Bird Observatory conducted 88 counts of carcasses on beaches during the peak eight-day period when live oiled birds came ashore. Most beaches were censused only once and counts were adjusted to estimate the cumulative total of dead birds washing in over the eight-day period. (Fig. 2). Totals were estimated using the live oiled bird daily beaching patterns in each coastal segment as an approximation of carcass deposition rates (Fig. 3) and a daily carcass persistence rate on beaches of 59.1% per day determined at the time of the spill (Page and Carter 1986). These counts were then extrapolated to areas not censused within the same coastal segment.

We estimated that 5880 dead oiled birds washed ashore during this period, compared to 3364 live birds sent to rehabilitation centers (Table 2; Page and Carter 1986). The two categories of impact indicated that species were affected differently by the spill. Ratios of dead to live oiled birds were near 1:1 for certain species like Common Murres and Western/Clarke's but were 40:1 for Rhinoceros Auklets and 19:1 for auklets/murrelets. These differences clearly demonstrated that both live and dead bird estimates of impact must be conducted to accurately assess the degree of impact on all species.

DEAD OILED BIRDS LOST AT SEA

We used a computer model to estimate the numbers of birds killed that did not wash up on shore. The model used hypothetical oil trajectories from the route of the *Apex Houston* (Fig. 1), based on real-time weather data, to ap-

proximate the path of oil slicks at sea (Ford et at. 1987). The distribution of birds at sea was determined at the time of the spill from aerial counts made by David Lewis and Breck Tyler of the University of California at Santa Cruz. By passing oil trajectories across the distribution of birds at sea, we simulated the path and speed by which birds killed by oil moved at sea in different areas of the spill. We then applied an at-sea carcass loss rate to account for the numbers of carcasses that were lost at sea. The model estimated the proportion of three species (Common Murre, Rhinoceros Auklet, Cassin's Auklet) that were lost at sea (Table 2). The model helped explain several aspects in large numbers because slicks hit large concentrations off Piegon Point and in the northern Gulf of the Farallones (Fig. 4). Fewer Cassin's Auklets were killed because they were concentrated primarily outside areas covered by slicks. Both Cassin's and Rhinoceros Auklets were usually dead when they reached shore because they were oiled farther away and took longer to come to ashore.

OVERALL IMPACT

By adding up the three categories of impact, we estimated that 10,577 birds of at least 26 species were debilitated or killed by the spill (Table 2). Live oiled birds constituted 31.8%, dead oiled birds on beaches 55.6%, and dead oiled birds lost at sea 12.6% of the total affected. Common Murres comprised 70.8%, Rhinoceros Auklets 14.8%, Western/Clark's Grebes 4.4%, and the rest 10.0%. This estimate is conservative because it applies only to the peak area and peak timing of beachings. In fact, over 1000 live and dead oiled birds were reported beyond these bounds. Also, at-sea loss estimates were derived for only three species whose at-sea distributions were well determined. Despite being conservative, the estimate of the number of birds impacted by the *SJVC* spill was about three times that of the 1984 *Puerto Rican* oil spill (PRBO 1985; Dobbin et al. 1986; Ford and Page, in prep.) More birds probably were affected during the 1971 San Francisco oil spill (Smail et al. 1972).

REHABILITATION CENTER DATA

Many problems confront rehabilitation centers when attempting to maintain accurate records which can be used to estimate numbers of live oiled birds that reach shore. The main problems are the convoluted fashion through which birds are transported from beaches to rehabilitation centers and an overriding concern for caring for live birds in centers. In Fig. 5, the flow chart outlines a simplified version of how birds were transported to rehabilitation centers from beaches during the *SJVC* spill. The various routes by which birds traveled made it difficult to keep data for individual birds in the accession records at centers. It is clear that, to be more accurate, data must be gathered as birds are removed from beaches. Current methods of transferring and recording data in accession records must be modified so as to be more useful for assessing damages to seabird populations.

Capture Date And Location

The date and location of live oiled birds captured on beaches are important data for determining the pattern and

Table 1

DATA SOURCE	CONTACT PERSON	COUNTIES FROM WHICH BIRDS WERE RECEIVED
Marin Wildlife Center, San Rafael	K. Thorne	Sonoma, Marin, San Francisco, San Mateo
Peninsula Humane Society San Mateo	S. Stadler	San Francisco, San Mateo, Santa Cruz
International Bird Rescue, Berkeley	A. Berkner	San Francisco, San Mateo
San Francisco SPCA, San Francisco	K. Karr-Warner	San Francisco
San Francisco Bay Bird Obs., Alviso	K. Hobson	San Francisco, San Mateo, Santa Cruz
Alexander Lindsay Jr. Mus., Walnut Creek	E. Anderson	San Mateo
Santa Cruz Native Animal Rescue, Santa Cruz	T. Wilson	San Mateo, Santa Cruz, Monterey
Monterey County SPCA, Monterey	L. Hoefler	Santa Cruz, Monterey

Table 1. Data sources for numbers of live oiled birds received at rehabilitation centers.

peak timing of live birds coming ashore on beaches and the variation along different parts of the coast. When an oil spill occurs without warning (as in the case of the *SJVC* spill), live bird beaching patterns may be used to estimate the deposition patterns of carcasses washing ashore, as long as they appear to be similar (Page and Carter 1986). Rehabilitation centers were inconsistent in how "date" and "location" were recorded in their records. Date sometimes referred to the date a bird was found on a beach and sometimes to the date it was received at a center. Both of these dates should be recorded at a center, but if only one is known, it should be clearly stated which date was recorded. Similarly, location sometimes referred to the beach where the bird was captured, the general area of coast (or county), the location of the collection or temporary-holding center, or the address of an individual or another rehabilitation center. If the specific beach location is not known, the best general locality should be recorded. Dead birds should not be removed from beaches for enumeration at rehabilitation centers because this would cause underestimation of mortality using carcass counts on beaches and would result in less reliable estimates of the numbers of dead oiled birds that do not reach shore. It is also desirable to keep records on the route birds travel between rehabilitation centers to prevent double counting of records kept at different centers.

Numbers of Birds & Identification

The numbers of each species of live oiled birds that are captured and taken to rehabilitation centers are crucial for assessing damages to specific seabird species. In particular, oiled birds must be clearly separated from non-oiled birds in center records. Each bird should be banded with a numbered plastic wrap-around band as it enters a center and the band number cross-referenced in the accession records. This will greatly assist keeping track of the bird during its stay at the center. Once banded, the initial identification of species, age, and sex of a bird that was entered in the accession records can be confirmed later by qualified personnel. All birds that arrive dead at centers also should be recorded individually in the accession records. These methods would prevent the use of approximate numbers for groups of birds brought in and prevent birds from not being recorded at all. These problems led to underestimation of the numbers of several species affected during the *SJVC* spill. Before release, the plastic band should be replaced with a stainless steel U.S. Fish and Wildlife Service (USFWS) band which lasts much longer than the standard aluminum bands that are presently issued by USFWS. Since seabirds are long lived, it is important to use bands that will not fall off before the birds die. Recoveries of such banded birds are useful for determining the long-term survival of rehabilitated birds.

FINAL COMMENTS

It is clear that records of live oiled birds sent to rehabilitation centers are an important part of the process of assessing the impact of oil spills on seabird populations. First, live oiled birds can constitute a large portion of the birds affected. Accurate records are required to determine the numbers of each species removed from beaches, especially for certain species which tend to reach beaches alive. Secondly, data on where and when live oiled birds are captured on beaches are essential for estimating how many dead birds wash ashore and how many are lost at sea. Rehabilitation centers must maintain accurate records so that an overall assessment of damage to seabird populations can be complete and reliable. This accounting role of rehabilitation center operations must be considered to be as important as the direct rehabilitation of oiled birds. As oil spill contingency plans develop in central California, both functions must be incorporated into the design of live oiled bird pickup and transportation, as well as the handling of birds within centers.

Table 2

SPECIES	ALIVE AND SENT TO REHABILITATION CENTERS	DEAD ON BEACHES	LOST AT SEA	TOTAL
Loons	128	148	—	276
Small Grebes	9	106	—	115
Western/Clark's grebes	155	313	—	468
Unidentified Grebe	19	—	—	19
Scoters	61	222	—	283
Common Murre	2924	3595	969	7488
Aucklets/Murrelets	9	168	29	206
(Cassin's Auklet)[1]		(140)	(29)	(169)
Rhinoceros Auklet	30	1201	335	1566
Other Species/Unid. birds	29	127	—	156
Total	3364	5880	1333	10577

[1]The number of Cassin's Auklets within the Auklets/Murrelets category is in parentheses.

Table 2. Estimated numbers of birds debilitated or killed by oil between 1 and 8 February 1986 from Salmon Creek, Sonoma County, to Point Lobos, Monterey County.

ACKNOWLEDGEMENTS

Our work was funded by grants from the San Francisco Foundation and the National Marine Sanctuaries Program (NOAA). We thank the staff of rehabilitation and collection centers cited in Table 1 for assisting with the compilation of data on birds received at centers and the many volunteers of the Point Reyes Bird Observatory that conducted carcass counts on beaches. This is Contribution No. 371 of the Point Reyes Bird Observatory.

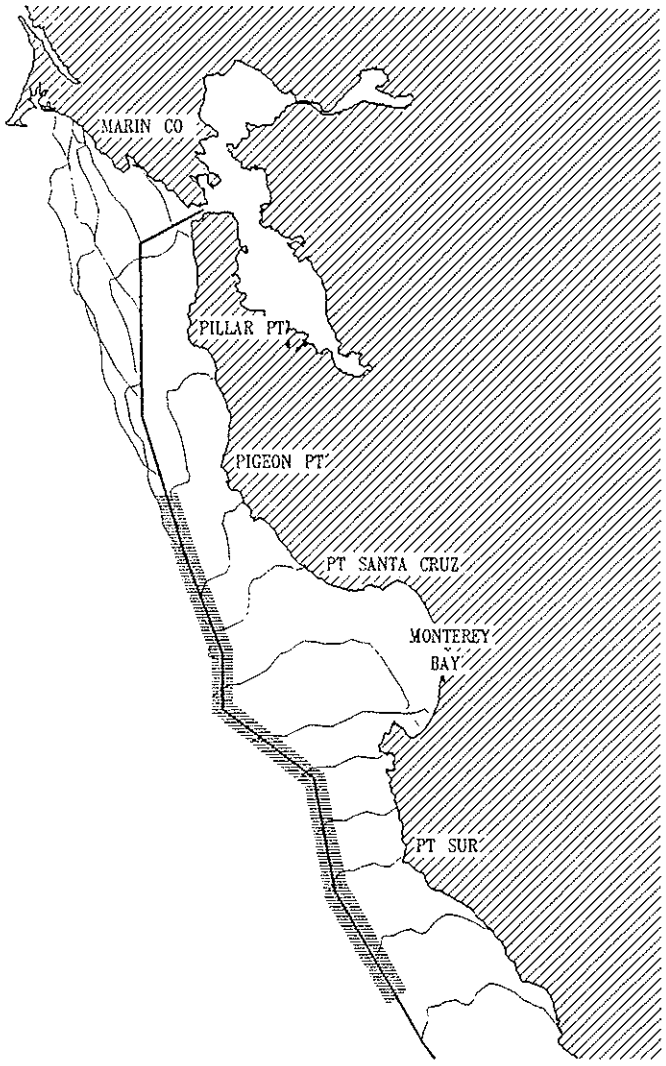


Fig. 1 Hypothetical trajectories of oil slicks launched at three-hour intervals from positions along the track of the *Apex Houston*. The shaded section of the track indicates the place where most oil was suspected of being spilled.

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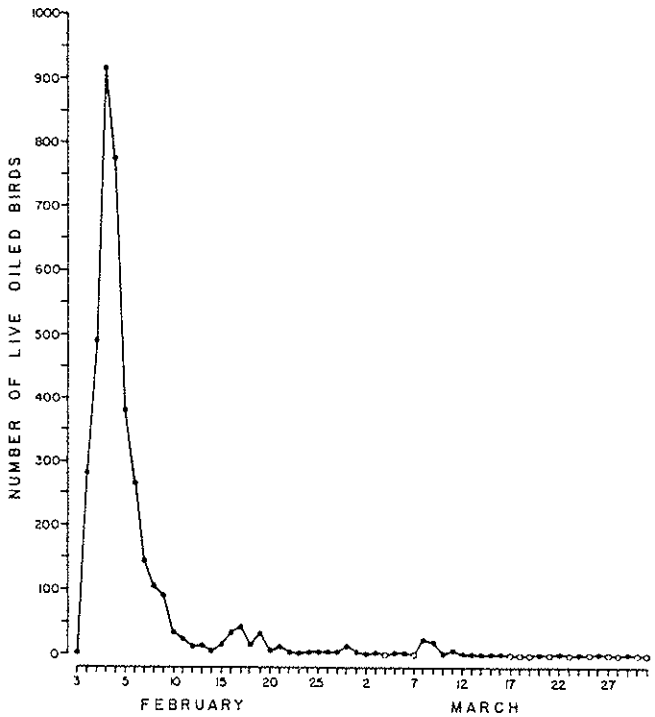


Fig. 2. Numbers of live oiled birds sent to rehabilitation centers between 1 February and 31 March 1986. Open dots refer to zero counts.

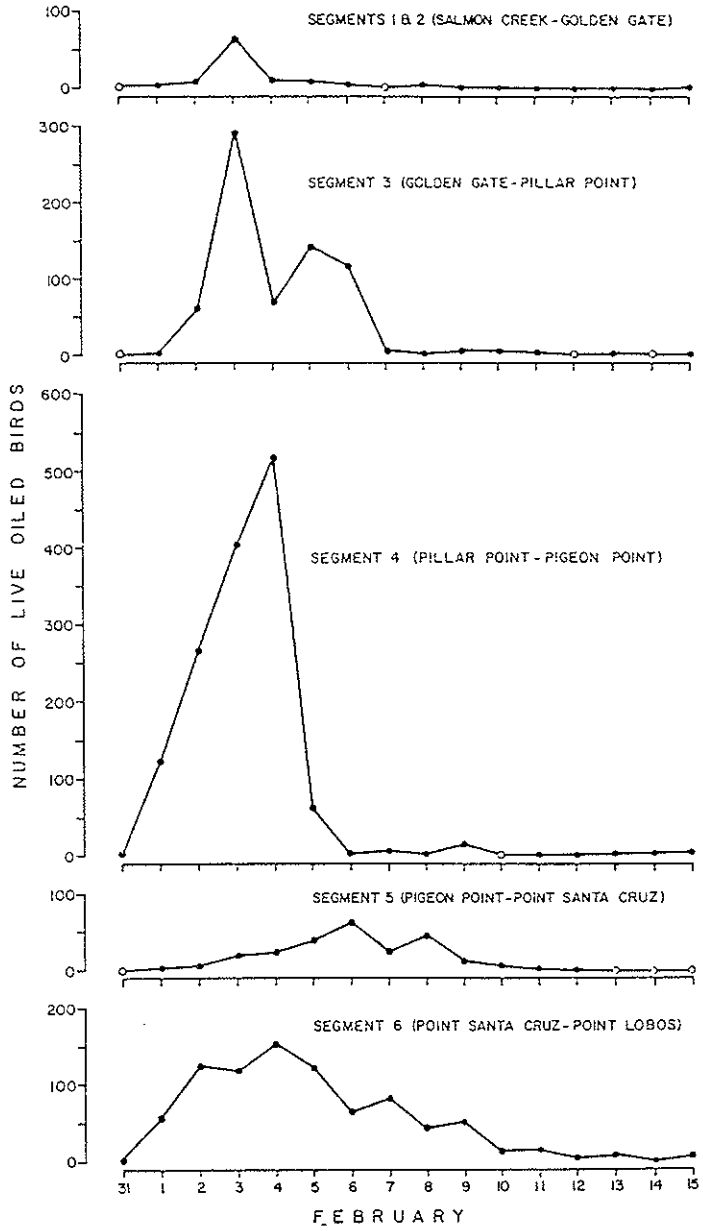


Fig. 3 Numbers of live oiled birds sent to rehabilitation centers from 6 coastal segments between 1 and 15 February 1986.

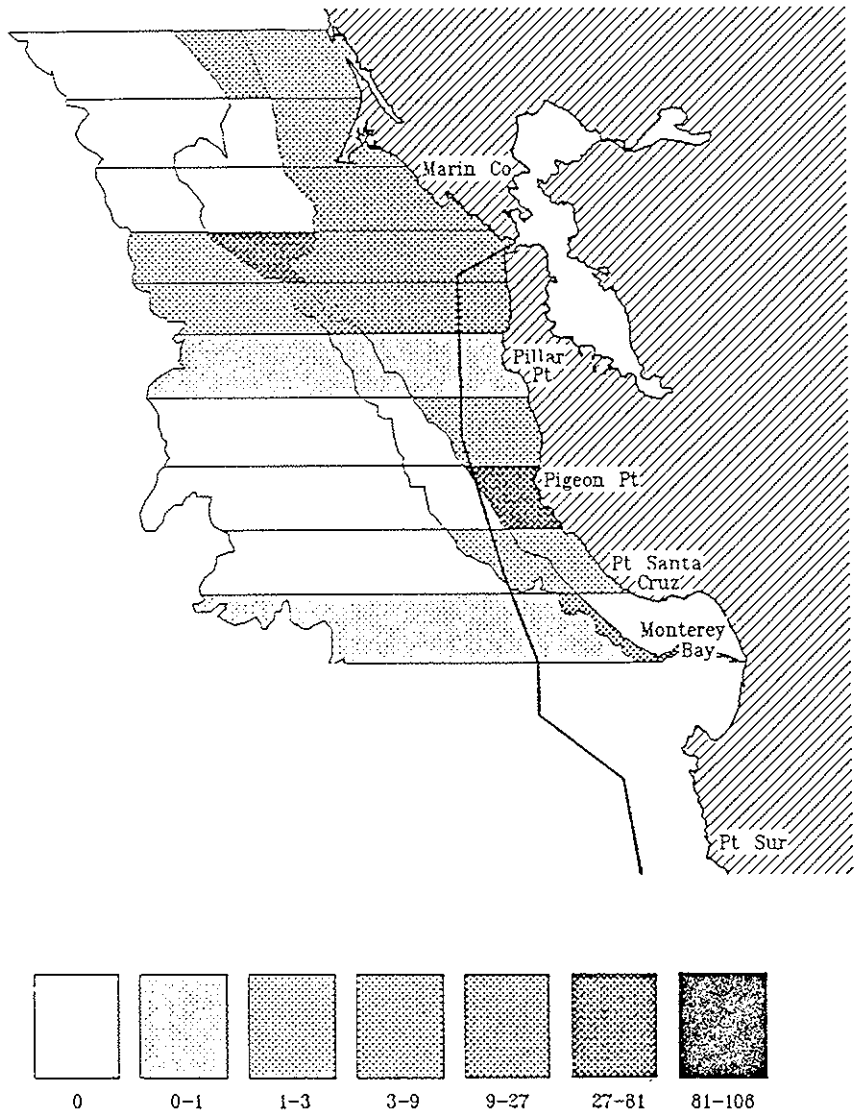


Fig. 4 At-sea densities of Common Murres on 5 February 1986. Intensity of stippling indicates bird density per km², as shown in the key. The dark line starting at the Golden Gate is the track of the *Apex Houston*.

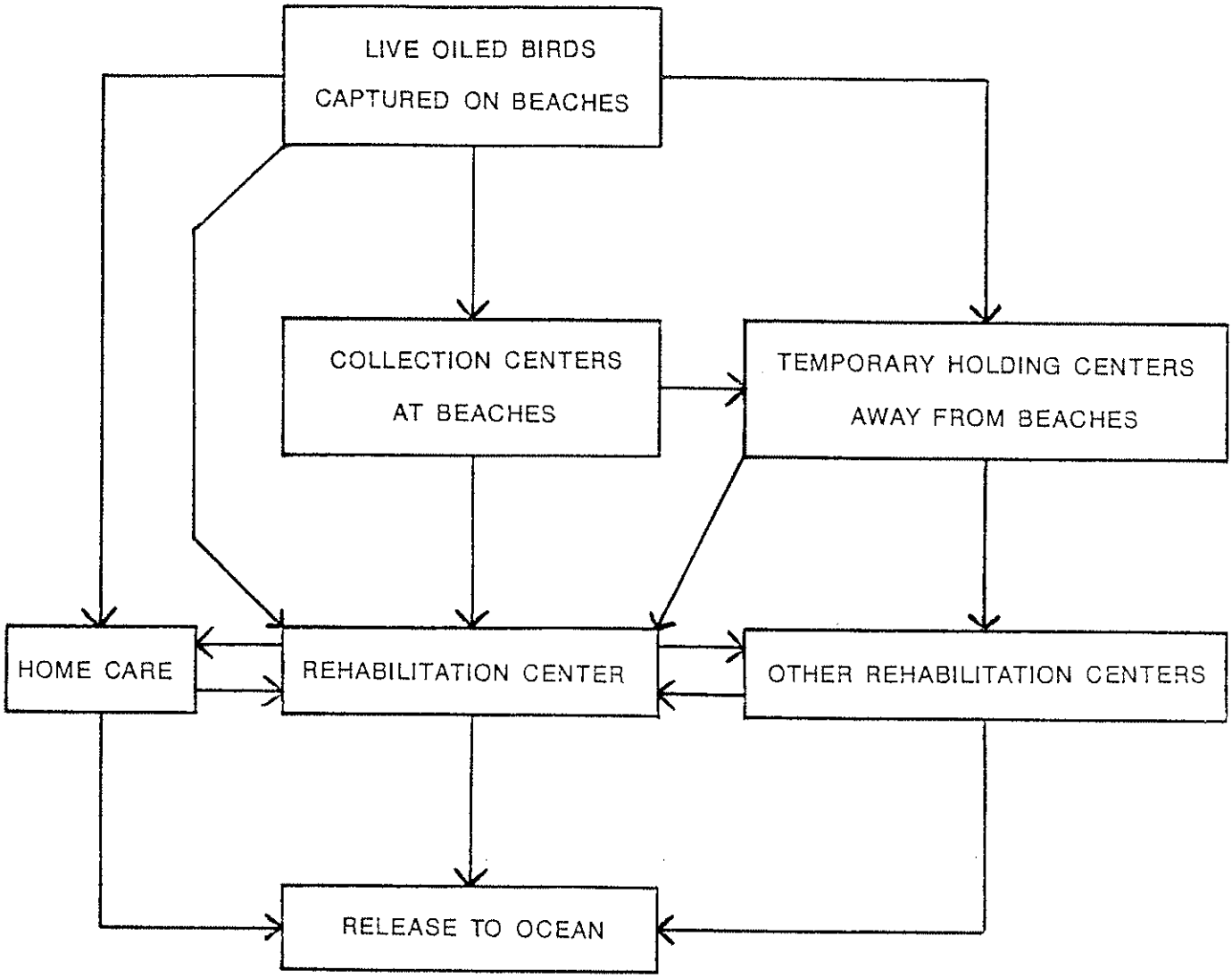


Fig. 5. Flow chart indicating how live oiled birds were transported from beaches to rehabilitation centers during the *SJVC* spill.

Notes on Bird Bands with Increased Longevity

Information regarding the longevity of plastic color bands and aluminum versus monel/stainless steel metal bands can be found with the following references.

ANDERSON, Alexander. 1980. "Band Wear in the Fulmar." *J. Field Ornithol.* 51(2)101-109.

ANDERSON, Alexander. 1980. "The Effects of Age and Wear on Color Bands." *J. Field Ornithol.* 51(3)213-219.

SPEAR, Larry. 1980. "Band Loss from the Western Gull on Southeast Farallon Island." *Field Ornithol.* 51(4)319-328.

For information regarding products that are currently available or their cost rehabilitators can write the following suppliers:

Plastic PVC Bands:
J.E. Warner
Observatory College
Potter's Bank
Durham City
England DH1 3RR

Stainless Steel Bands:
Lambourne's (B'ham) Limited
Colman House - Sales Office
Station Road
Knowle
West Midlands
England B93 OHL

For the New Rehabber:

Salting Avian Nasal Glands

Jay Holcomb
International Bird Rescue and Research Center
Berkeley, California

A pelagic bird is a bird that lives its entire life on the open sea and occasionally uses land for resting or rearing young. Pelagic birds drink sea water, therefore they need to be able to process and eliminate excess salt. Their main salt eliminating organ is not the kidney but a special gland in the head which disposes of salt more rapidly than any kidney does. Samples of secretions from the gland are an almost 5% solution of sodium chloride-nearly twice as salty as sea water.

Pelagic birds kept in captivity for long periods of time without a regular intake of salt can loose the ability to utilize salt water. If released back to salt water with a non-functional salt gland, they can suffer rapid dehydration and die. Therefore it is important to maintain a functioning salt gland prior to release.

While not much scientific research has been done on the specifics of maintaining a functioning salt gland, practical experience has over the last fifteen years given the rehabilitators guidelines that prevent the problem.

An effective way to maintain a functioning salt gland is to tube the bird with a 3% salt solution. This can be made by mixing 6 tsp. salt to 1 liter of water once a day during the duration of captivity. This will continually stimulate the gland and prevent the risk of dehydration when the bird is released.

This procedure works well when you have time to do it. During oil spills where large numbers of pelagic birds are involved, it may be difficult to give this kind of attention to each bird. There are also individual cases where birds are not able to be tubed a salt solution during their captivity. This procedure is contraindicated in birds who are in a dehydrated condition.

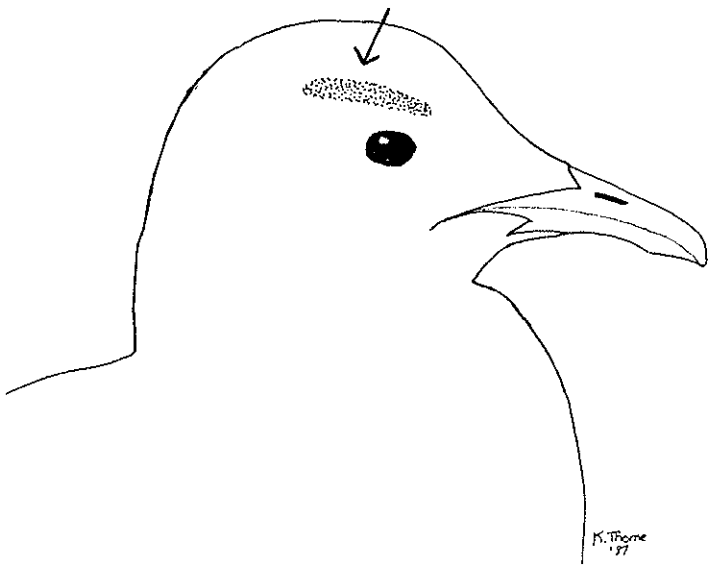
Birds kept under 10 days with no salt intake can be released without giving salt water provided that the function of the gland is checked. This test should be performed on every pelagic bird who has been in captivity over 10 days.

Testing the Function of the Salt Gland

Two days prior to release, remove the bird from its pool and place it in a cage with no access to water other than any that may be mixed with the food. Do this in the morning so that you have all day to observe the bird. Begin by tubing the bird with a 1% salt solution every three hours. A 1% solution can be made by adding 1½ tsp. salt to 1 liter of water.

Observe the bird's behavior for about every 20 minutes for the first few hours for signs of salt toxicity. These signs may include: loss of appetite, convulsions, tremors and lethargy. If the bird shows any of these signs, tube fresh water immediately every one half hour for the next 2 hours until the bird's condition is stabilized. It should then be given access to a fresh water pool for the next 24 hours. A second salt solution trial can be repeated after that time.

If the bird is eating well and shows no signs of salt toxicity, begin tubing the bird with a 3% salt solution the morning of the second day. Most birds have no apparent reaction to the salt solution during the first attempt. The few who do usually adjust on the second trial. If there are no reactions to the solution after five hours put the bird in a



Arrow indicates location of salt gland in a gull.

pool. The bird should be tubed a 3% solution (24 hours later) prior to release. The bird is ready for release when it has adjusted to the salt solution, and has met the other regular criteria for release (i.e., it is waterproof, adequately fleshed, feeding, and capable of carrying on the hunting, feeding or migrating activities required at the time of release.)

Rehabilitators should note that not all aquatic birds are pelagic. Many aquatic birds adjust easily from fresh to salt water and do not require tubings of salt solutions. See chart for listings.

Families of Non-pelagic North American Water Birds

Loons
Grebes
White Pelicans
All Cormorants except Pelagic Cormorants
Anhingas
Swans
Geese
Surface Feeding ducks
Tree ducks
Bay ducks and Sea ducks
Stiff-tailed ducks
Mergansers
Herons and Bitterns
Storks
Ibises and Spoonbills
Flamingos
Cranes
Limpkins
Rails, Gallinules and Coots
Jacanas
Avocets and Stilts
Plovers, Surfbirds and Turnstones
Sandpipers and Allies
Phalaropes
Gulls and Terns (See pelagic listings.)
Skimmers
Kingfishers

Families of Pelagic North American Water Birds

Albatrosses
Fulmars, Shearwaters and Petrels
Tropicbirds
Brown Pelican*
Frigatebirds
Gannets and Boobies
Pelagic Cormorant
Oystercatchers
Jaegers and Skuas
Black-Legged Kittiwake
Sooty Tern, Noddy Tern
Alcids

* Even though Brown Pelicans live in a pelagic environment they have been sucessfully rehabilitated on fresh water and released back to sea water with no ill effects.

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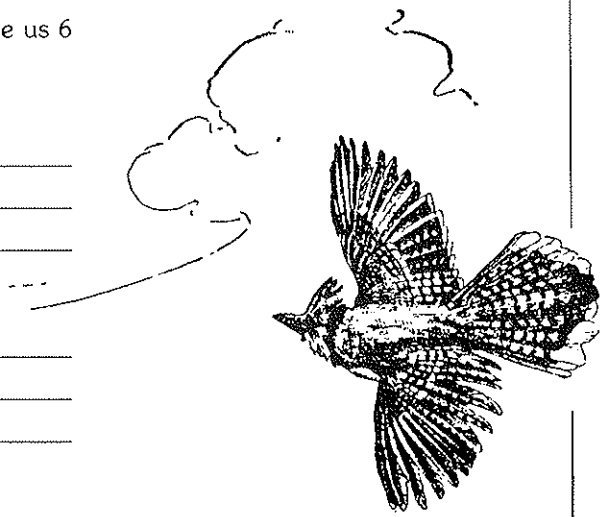
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Oil Spill Rehabilitation: Results & Recommendations for the Future

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Coast Veterinary Hospital
Seaside, California

INTRODUCTION

The *Apex Houston* oil spill resulted in tremendous numbers of contaminated birds, countless man and woman hours attempting to rehabilitate these animals, and, to my knowledge, an undetermined amount of money in this rescue effort. Anyone who participated in this clean-up effort is certainly aware of the frustration which occurred as a result of the myriad of problems encountered. What do we know now that we were unaware of then? How do we best handle these birds? What can we do to treat or better yet prevent some of the secondary and tertiary problems noted in the birds? This article will attempt to address some of these questions and provide some suggestions for handling birds and rescue efforts in future oil spills. Much more information must be obtained, more research done, and many questions answered. Comments, questions, suggestions and discussion on this subject are invited.

The problems noted in the birds have been broken down into three levels, primary, secondary, and tertiary, for the sake of simplicity in addressing the apparent effects of oil and captivity on the birds. This breakdown is basically arbitrary and obvious overlap does occur.

PRIMARY PROBLEMS

The primary problems are those which have already occurred in the birds prior to their admission into a rehabilitation facility. These include hypothermia, dehydration and electrolyte imbalance, shock, stress, anemia, and many other effects which tend to vary species to species and individual to individual. Since these have already occurred before we see the patient, we must direct our initial efforts towards correcting these problems, if possible, and preventing further increases in their severity.

Of these primary problems, the three that will be addressed are dehydration, stress, and anemia. The dehydration is always accompanied by electrolyte imbalance and appears to be the result of aberrant osmoregulatory functions caused by the ingestion of oil. Since we are dealing with not only fluid loss, but also electrolyte loss, it is imperative that we provide a balanced fluid and electrolyte replacement solution. One would furthermore anticipate impaired gastrointestinal function as a result of the oil which would limit the ability to digest and assimilate complex nutrients. Therefore, products which require minimal digestive action are recommended. Two such products are Life Guard® and Pedialyte®

Bunker C fuel induced Heinz-Body hemolytic anemias have been well documented by researchers and rehabilitators working in the *Puerto Rican* oil spill as well as the *Apex Houston* spill. Tremendous numbers of blood samples (PCV, and smears) were taken by researchers, rehabilitators, and a team of veterinary students from U.C. Davis. The samples have been reviewed for parasites, evidence of infection, plasma protein content and regenerative efforts by the animal. We now have a much better idea of what is actually happening to the birds.

Heinz-body hemolytic anemia is caused when the birds are exposed (mainly by ingestion) to certain fuels. While the nature of the Heinz body has been debated for years, there is general agreement that they are formed by precipitation of oxidatively denatured hemoglobin. They form initially as several small granular bodies in the red blood cell and then coalesce into one body. The problem is that they deform the red blood cell and when these cells enter the spleen they are unable to pass through the microcirculation and are eventually phagocytosed (broken down). This results in a precipitous drop in the packed cell volume of the affected birds. The birds are therefore carrying much less oxygen through their circulatory system and the result is lethargy and a bird with a reduced capacity for hunting or diving. The birds do respond given good supportive care and a high plane of nutrition over a period of 30-45 days.

Since there is no known way to reverse this type of anemia, we must look for ways to minimize exposure to the toxin. Birds should be picked up as soon as is humanly possible and presented for cleaning. If the bird is stable, it should be cleaned immediately. If the bird cannot be cleaned immediately, further oil ingestion should be mechanically prevented. Rehabilitators will be working further on methods to do this. Current methods include the use of Elizabethan collars, stockinette "sweaters", paper wraps, and other devices.

Since there is most likely some oil remaining in the gastrointestinal tract upon admission, administration of some compound to preclude further absorption of oil appears prudent. Admittedly, normal gastrointestinal transit time is very short, however, we are not dealing with a normal bird. Presumably, the transit time will be somewhat longer. For that reason ad-

ministration of activated charcoal is indicated. Other authors have recommended the administration of 1-3 ml of Pepto Bismol at the time of admission.

Stress, not to be confused with anxiety, is an obvious problem in the oil contaminated bird. Efforts must be made to minimize the stress placed on the bird, however, it is impossible to totally eliminate them. This can be done by being prepared with supplies or instruments before the bird is brought from a pen to be tube fed, treated, or otherwise handled. Birds can be housed away from main treatment, intake, or cleaning areas so that when they are not constantly being stressed by activities that don't concern them.

SECONDARY PROBLEMS

The secondary problems are those which tend to occur shortly after admission to a rehabilitation center. These include continued hypothermia, overcrowding, anorexia, dehydration, obstipation (especially in loons and grebes), more stress, and continuing anemia. Certain species of waterbirds (i.e., loons, grebes) may hold fecal material and urine when out of water. Before the oil is cleaned off the birds, they are not placed in pools to swim. These birds may be placed in a shallow pan with tepid water briefly to include defecation.

Overcrowding is a management problem that should be prevented. Different species of birds have varying requirements for privacy. Trained rehabilitators learn what species can be housed together and how many in a given pen.

Hypothermia, anorexia, and dehydration are medical problems that are routinely handled effectively in bird cleaning centers. Drying pens are used to warm birds. Electrolytes and feeding regimens which are constantly evolving are used to combat dehydration and anorexia.

TERTIARY PROBLEMS

The tertiary problems are those that generally occur after an extended stay in a facility. Included in this category are foot and leg problems, corneal disease, decubital ulcers, feather impaction of the proventriculus (especially in loons) malnutrition, thiamine deficiency, aspergillosis, persistent anemia, re-oiling due to fecal oils, and more stress.

Foot and leg problems seem to be most common in the murres. The lesions take a "bumblefoot-like" appearance on the plantar aspect of the foot and ventral aspect of the hock. We really don't know how to prevent these lesions, but some suggestions are: 1) get the birds back into the water as soon as possible; 2) try to prevent the problem with the best housing available. Currently, birds are housed on netting where they defecate through the net (away from their feathers) and walk on a "soft springy surface". While this is a vast improvement over the use of plastic bubbles that were used in previous spills, it does not prevent bumblefoot in all species under prolonged care. It might be a good idea to try a method used at the National Aquarium in Baltimore where the penguins are supplied with an area of cat litter on which to stand. The birds will actively seek out these areas in which to stand and no additional therapy for this problem has been required.

Corneal disease, a wrinkling of the cornea with resultant blepharospasm (spasm of the orbicular muscle of the eyelids), was noted in murres at the Moss Landing facility after extended stays in birds which had not been bathed. Again, early bathing appears to be the key.

Aspergillosis proved to be one of the most frustrating problems encountered. Clinical signs of the malady are quite non-specific, and the diagnosis was often made at post mortem examination. A number of birds were diagnosed with the use of laparoscopy. As *Aspergillus* spores are ubiquitous, one may suspect that immunosuppression, either as a result of chronic stress or a direct effect of the oil, is important in the pathogenesis of this problem. To this date, there has been no success in the use of chemoprophylactic agents to prevent infection. The key at this time appears to be minimize stress and return to the wild as soon as possible.

Recontamination of feathers from fecal oils has been reported to be a problem. The use of pools which have water constantly flowing over the rim may be adequate to skim oil, from the surface of the water. Obviously, use of netting or other similar device is necessary to keep the birds within the pool.

Having outlined some of the problems noted during these last two California oil spills, I have formulated a list of recommendations for handling birds in future oil spills. Again, I encourage feedback on any or all these suggestions.

1. *Admission record:* While all the birds in a cleaning center have some kind of record, during the last spill due to the tremendous numbers of birds, many birds ended up in general rehabilitation centers along with the regular caseload. Overwhelmed, not every bird had a medical record. Each bird deserves an individual medical record. I recommend that they be standardized and should include at a minimum the dates of entry/disposition, extent of oil contamination (a diagram of a bird to circle affected areas may facilitate compliance by workers), admitting weight, admitting PCV/total proteins, species, number and color of temporary leg band number. In a spill with one central cleaning facility the items above have been the normally recorded with the exception of the blood values. On a large scale basis, this was the first time blood was taken. Over 600 samples were taken in 5 locations. Our best two-man team working a ten hour day in a good day took samples from 100 birds. A more typical days effort for two trained people would be 50-60 birds. While this is no easy task, it is a vital part of continuing research on the problem as well as a good criterion for release for clean waterproof birds who are otherwise ready for release. It was used as a criterion for euthanasia since birds with extremely low PCV's were highly unlikely to recover given the problems they faced (i.e., long term care).

The record should follow the bird through the rehabilitation process so that the date of bathing, subsequent weights, and hematological parameters may be noted. Use of medical records will allow after-spill evaluation of general trends and answer many of our current questions. Those questions include: how does the extent of oil contamination versus the amount of oil ingested effect releasability? How low can the PCV be and still have a bird that is ultimately releaseable? How many days can we wait before bathing? Is there a cut off date? With records which record carefully selected data, we may be able to answer these questions.

2. *Determination of admitting PCV/Total Protein.* A great deal of information was learned in this latest spill regarding the significance of the PCV in birds oiled with Bunker fuels. I recommend that birds with a PCV less than 20% be

euthanized upon admission. Starting at 20%, it will take approximately 30 days for the PCV to increase to a level high enough for the birds to be released. Species that cannot be maintained for that length of time (i.e., loons, murres) probably will succumb to one or more tertiary problems already discussed and euthanasia should be considered. By establishing cut-off points on an objective scale, a consistent triage system can be set up and utilized effectively.

3. *Arrest further absorption and ingestion of oil.* The administration of an activated charcoal slurry at the time of admission is intended to preclude further absorption of oil which may still be present within the gastro-intestinal tract. Some rehabilitators from the east coast recommend administration of Pepto Bismol at the time of admission as a protectant for the damaged gastro-intestinal mucosa (Dein and Frink, 1986). New methods must be developed to prevent further ingestion of oil. Current options utilized include Elizabethan collars, stockinette sweaters, or paper wraps.

4. *Rehydration.* Ideally, the birds would receive parenteral fluids to manage their fluid/electrolyte imbalance. That is, to say the least, wholely impractical and will never happen. Previous recipes for rehydration have relied on water, sucrose, small amounts of dextrose, and sodium chloride. With the availablity and convenience of more balanced electrolytes solutions using dextrose as the energy source, there is no reason not to incorporate such supplements into the oil spill rehabilitation effort. Two such products available are Life Guard® (Norden Laboratories, Lincoln, Nebraska) and Pedialyte® (Ross Laboratories, Columbus, Ohio). These fluids should be warmed prior to use and the gavage should be repeated every 6-8 hours until body temperature meets or exceeds 101°F.

5. *Know your limitations.* Each center should have a maximum numbers of birds that can be effectively handled at one time. It serves no purpose to exceed these census ceilings, as once surpassed, the quality of care is bound to decrease for all patients. If the number of anticipated admissions exceeds the limit, then take into consideration those areas where the most severe bottle-necks are anticipated to occur: admission, bathing, and swimming-release. Limits should also be established based on species. There is a lot of difference between cleaning and housing 50 murres versus 50 pelicans. One other area to consider in establishing limits is in dealing with the volunteers. While the untrained volunteer pool is important, we must have a pool of trained volunteers. They must be trained on site, and integrated into the system without disrupting everything. They need to be channeled where they are most valuable. Assigning an experienced person to train and work with the untrained individual may be one solution.

6. *Nutrition.* Do not rely on fish as the main source of nutrition for these birds. Many of them are anorectic or consuming inadequate quantities to maintain body weight. Additionally, and more importantly, the nutritional quality of the fish offered the birds is generally much, much less than desired. It is impossible to fully meet the nutritional requirements of picivorous birds using one fish type for food. The nutritional quality is dependent upon so many variables that it is impractical to attempt to formulate whole fish diets as required in these rehabilitation programs. Variables such as temperature and rate of freezing, storage temperature, storage humidity, age of fish in storage, season the fish were collected, sex of the fish (pre or post spawning), rate and method of thawing, and time fish spend in the bird pens and pools will all have dramatic effects on the nutritional quality of the food source. Additionally, the amount of kilocalories available ranges widely from 500-1200 per pound (Fowler, 1986).

In order to provide adequate nutrition for these birds, it is recommended that tube feeding be accomplished 2-3 times daily using the recipe listed. Initial feeding volumes should be less than 5% of body weight and gradually be increased to 10-20% of the body weight per day. If the bird is still not allowed free access to water, the formula may be diluted 50:50 with Life Guard® or Pedialyte® to assure adequate fluid intake. In these cases the volume and frequency of feeding should be increased 15-25% of the body weight daily.

TUBE FEEDING FORMULA

2 Cups	Purina Hi-Protein Puppy Food
6 Scoops	Pro Sobee® (a soy based, glucose infant formula (without sucrose or lactose)
2-3 Tablespoons	Soy Bean Oil (high in linolenic acid)
1.5 Cups	Water to soften dog food

Admittedly, tube feeding each bird is time consuming and stressful to the bird, but as much if not more stress is the result of chronic malnutrition. Ad lib offerings of fish may be utilized, but one must remember that the bird eating large quantities of fish will have less volume for tube feeding formula upon which we are relying for proper nutrition of the bird.

This diet has not been tested on large numbers of birds and is intended to be used as a starting point. As more experience is gained, the diet will evolve. Feedback from rehabilitators using the formula is requested and appreciated.

7. *Bathing.* Experience gained last year tends to indicate that the main key to success in these birds lies in getting the birds bathed and back into the water as soon as possible. Prior to bathing, ensure that the bird is bright, alert to its surroundings, responsive, and has a body temperature of at least 101°F. Bathing should be performed on a prioritized basis. Loons and grebes don't do well in captivity and should be bathed first.

8. *Monitoring.* A system for routine monitoring and recording PCV, total protein and body weight should be established. Ideally, weights are taken during the same time of day for the bird and prior to tube feeding. Values obtained should be noted in the medical record.

9. *Foot and leg problems.* Watch each bird very closely for evidence of foot and leg problems. Once the skin has been violated and the bacteria have entered the subcutis and deeper tissue planes, the prognosis for recovery is guarded to grave. The bacteria and the body's exuberant purulent, caseous exudate tend to destroy the normal architecture of the foot and leg. This results in extensive inflammation around tendons and joints with subsequent crippling effects. Birds with active or chronic infections cannot be released. The best treatment at this time is prevention. Birds should

be placed on netting. The cat litter idea has merit and should be tried in a rehabilitation setting.

10. *Waterproofing.* An experienced rehabilitator should be appointed as the "swim coach" with the responsiblity of monitoring bathed birds in the water. Signs of hypothermia or inadequate waterproofing should be dealt with promptly. The birds generally are rewashed, dried and then placed in the pool again for observation.

11. *Feather Contamination.* There have been several reports of recontamination of the feathers with oils in the fecal material. Birds who have food and feces on their feathers will not repel water. Oily fish should not be left in the pools. This problem can be prevented by setting up the pools in such a way as to ensure the constant flow of water over the edges of the pools. Pools should be designed in such a manner to control this problem. Swim coaches should be aware of this potential problem in their pools and monitor water quality.

12. *Isolation.* All areas in which birds are held should be designed in such a manner that visual and auditory contact with humans is minimized. Constant visual contact with the helter-skelter operation unique to oil spill rehabilitation centers can not be healthy for our patients and is one stressor that should be reduced as much as possible.

13. *Recommendations for Release.* The current recommendations for release are: a) a stable or increasing body weight that is 75% or better of normal for that species given the time of year; b) PCV greater than 40%; c) no evidence of active or chronic foot and legs problems which penetrate the skin; d) clean intact feathers and good waterproofing. It should be noted that relatively small areas of exposed skin in sea-going birds will result in severe hypothermia that can result in a fatality.

14. *Finish the Records.* Once the decision has been made to release the bird, complete the record with information such as date released, exit PCV, total protein, weight, location released, and Federal band number. Use of bands offers us the best opportunity to follow the birds and evaluate our success.

CONCLUSION

The business of cleaning and rehabilitating oil contaminated birds has been evolving for several decades. While much has been learned, much more remains to be worked out to maximize the success of our efforts and minimize the human impacts on these birds.

We can no longer rely on a handful of dedicated volunteers to devote 10+ hours a day to see that the system moves smoothly. We need to set up a system of paid supervisors who are both trained and experienced in this work. We need to establish on-going training classes in various locations as well as maintain current lists of available graduates.

While it is routine for supplies to be stock piled in advance, more supplies were necessary in this last spill than were readily available. This spill was a large one and pointed out the pressing need to be prepared. If we want to try using Elizabethan collars, they too should be prepared in advance.

I hope that this article will stimulate discussion by those involved in this kind of efforts. I will welcome any comments.

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