BEACH SURVEYS PAST, PRESENT, AND FUTURE: TOWARD A GLOBAL SURVEILLANCE NETWORK FOR STRANDED SEABIRDS

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INTRODUCTION

Many beached bird monitoring programs have been established in response to chronic oil pollution or as the result of a specific oil spill that affected wildlife (for example, Camphuysen & Heubeck 2001, Carter *et al.* 2003, Wiese & Elmslie 2006). Quantitative information on seabird mortality stemming from such efforts is largely confined to Western Europe, North America, South Africa and New Zealand (Camphuysen & Heubeck 2001, Wiese & Elmslie 2006). In Europe, the first reports of oiled seabirds were published in the late 19th and early 20th centuries (Gray 1871, Mothersole 1910), but it was only after 1915 that oiled birds were observed frequently (Verwey 1922, Wild 1925).

In the United States and Canada, large numbers of oiled seabirds were reported through the mid-to-late 20th century. In comparison, reports of oiled birds are relatively rare in both South Africa and New Zealand, with the exception of several major oil spills that occurred during the late 20th century (Morant *et al.* 1979, Knight 1993). Elsewhere, regular findings of oiled penguins have recently raised concern about chronic oiling in Argentina (Gandini *et al.* 1994, Garcia-Borboroglu *et al.* 2005).

Although beached bird programs frequently start as informal efforts, once the value of the data is realized, they evolve into systematic monitoring programs with standardized protocols for consistent data collection. An exception to the usual impetus for monitoring programs is a long-term beached bird survey in New Zealand (Veitch 1975a, 1975b, 1976). Established in the 1940s, much earlier than most programs, the New Zealand survey was undertaken to understand the impact of storms and weather on marine birds (Powlesland & Imber 1988, Powlesland & Pickard 1992).

DETECTION OF OILED WILDLIFE VIA BEACH SURVEYS: CHRONIC VERSUS ACUTE OIL POLLUTION

Most beach surveys have been established to document chronic or catastrophic oil pollution, or both, but the methods used and the information obtained often vary depending on the objective considered to be paramount. In the case of chronic pollution, surveys are routinely performed by volunteers associated with a specific program (Fleet 2006, Harris *et al.* 2006, Heubeck 2006, Wiese & Elmslie 2006, Žydelis *et al.* 2006), and oiled carcasses or samples of oiled feathers usually are not evaluated to determine the source of the oil. This situation differs from the typical oil spill event, when the volunteer workforce is often supplemented or replaced by oil spill response personnel, resource agency staff or natural resource damage assessment (NRDA) personnel (Ford 2006, Hampton & Zafonte 2006, Helm *et al.* 2006).

Because oil spills often have an associated responsible party and because (in the US) a formal NRDA assessment is conducted, oiled birds serve as legal evidence and must be sampled, handled and processed to safeguard the chain of custody and to provide valid, irrefutable evidence that ties the oiled bird to the responsible party. Oiled feathers are often collected and analyzed through "chemical fingerprinting" to match the oil on injured birds with oil from the known source of the spill (for example, Page *et al.* 1990, Carter *et al.* 2003). Thus, although the samples are essentially identical, the disposition of a chronically oiled bird is generally different from that of an oil spill–contaminated bird. Because of presumed difficulties in pinpointing potential sources, important diagnostics that could help to identify the source or sources of chronic oil pollution are rarely performed.

An exception to the foregoing generalization is the case of the *SS Jacob Luckenbach* in California. This vessel, which sank after a collision in 1954, ultimately was identified as the source of a mystery spill that killed large numbers of seabirds in the Gulf of the Farallones in 2002. Oil fingerprinting has also established that material leaking from this vessel was responsible for several other mystery oiling events that occurred earlier in the 1990s. As a result of those findings, natural resource damage claims were filed and they have led to seabird restoration efforts (Hampton *et al.* 2003).

Many variables affect the number of birds recovered on beach surveys following an oil spill. They include, but are not limited to, the rapidity with which a search effort is initiated, the experience of survey participants, the length and type of terrain that needs to be searched, carcass sinking rates and persistence on beaches, wind and weather, time of year, the direction and magnitude of tides and currents, and the species affected (for example, Camphuysen 1989,

1998; Van Pelt & Piatt 1995; reviewed by Camphuysen & Heubeck 2001; Wiese & Jones 2001; Seys *et al.* 2002a; Carter *et al.* 2003; Wiese 2003; Wiese & Ryan 2003; Ford 2006; Hampton & Zafonte 2006; Helm *et al.* 2006).

Once carcasses have been counted and the percentage of oiled versus non-oiled birds is known, an estimation of the total numbers of birds affected is attempted (for example, Piatt & Ford 1996, Helm *et al.* 2006). Extrapolation is a standard element in oil spill damage assessment, but it is not consistently a part of beached bird programs that focus on chronic oil pollution (but see Wiese 2002, Wiese & Ryan 2003, Wiese & Robertson 2004, Wiese *et al.* 2004). Extrapolation of chronic oiling rates to population-level effects would greatly enhance the influence of beached bird monitoring programs globally (Wiese & Elmslie 2006).

Although some will debate the value of monitoring programs for oiled wildlife, damage assessments or the effects of oil on seabird populations, strides have been made to address chronic oiling issues on national levels, largely in response to evidence from beached bird surveys. Legislation to increase surveillance and fines for illegal bilge waste dumping passed last year in Canada after extensive effort and many years of surveys documenting the extent of the chronic oiling problem in the Maritime provinces (Wiese & Elmslie 2006). In the North Sea, beach surveys of long duration provide concrete evidence of local changes in chronic oil pollution (for example, Heubeck 1991, Seys *et al.* 2002b). A downward trend in oiled bird carcass recovery in the region occurred following implementation of government-funded bilge reception facilities and surveillance (Averbeck 1991, Camphuysen 1998, Fleet & Reineking 2000). In the context of chronic pollution, the science of oil fingerprinting is more limited in application, and yet it has made possible at least the narrowing of the source of most chronic pollution on feathers to bilge waste (Wiese & Ryan 2003).

BEYOND OIL SPILLS AND CHRONIC OIL POLLUTION MONITORING: A GLOBAL SEABIRD SURVEILLANCE NETWORK

A review of bird mortality events over the past 30 years makes it clear that exposure to oil is not the only anthropogenic threat to seabird health. Mortality also results from fishing gear entanglement and fisheries bycatch (Julian & Beeson 1998, Forsell 1999, Kiyota 2002, Žydelis *et al.* 2006), pesticide and chemical exposure (Borga *et al.* 2001, Burger & Gochfeld 2004), vegetable and fish oil spills (IMO 1994) and ingestion of plastic (Auman *et al.* 1997, Pierce *et al.* 2004, Van Franeker *et al.* 2004). Natural mortality factors include trauma, severe weather and starvation (Nevins *et al.* 2005, Scheffer *et al.* 2005), infectious diseases—viral, bacterial, fungal and parasitic (Friend *et al.* 1999, Rocke & Friend 1999, Work & Rameyer 1999, Friend *et al.* 2001, Muzaffar & Jones 2004, Newman et al. 2007)—and toxic algal blooms (Coulson *et al.* 1968, Work *et al.* 1993, Shumway *et al.* 2003).

Although it is important to document the numbers of birds recovered during beach surveys, it is equally important to determine the cause of death (for example, Stephens & Burger 1994). For effective conservation, we need to distinguish natural and anthropogenic sources of mortality.

Today, beached bird monitoring programs are valuable for monitoring the health of coastal ecosystems locally, but a larger seabird surveillance network employing standardized data collection protocols could be a much more powerful tool for evaluating large-scale changes in marine ecosystem health (Furness & Camphuysen 1997, Newman et al. 2007). Such efforts exist on a limited international scale (for example, OSPAR 1996), and linking all such programs globally is an important next step. A seabird surveillance network modeled after the U.S. Marine Mammal Stranding Network (www.nmfs.noaa.gov/pr/health/networks.htm) could

- standardize data collection internationally (Seys *et al.* 2002a).
- encourage more extensive geographic coverage.
- establish a shared, open access database of information from all beached bird programs.
- incorporate data from both dead beachcast birds and live injured birds (Camphuysen & Heubeck 2001, Seys *et al.* 2002a).
- facilitate early detection of emerging infectious diseases (Newman et al. 2007).
- comprehensively quantify the effects of contaminants and other anthropogenic impacts on marine bird populations.

Because chronic oil pollution is a major cause of beachcast birds, establishing an international "oil fingerprint" library could provide valuable information to countries that may want to investigate sources of chronic oil pollution, but may not have the infrastructure or financial and political means to do so.

We emphasize that a global seabird surveillance network should include standardized data collected from injured or debilitated live birds recovered by rehabilitation centers (Camphuysen & Heubeck 2001, Seys *et al.* 2002a). Advantages to working with birds at rehabilitation centers include the opportunity to collect biologic samples from live birds and to perform necropsies on birds that die in care. Samples (blood; oropharyngeal, tracheal or cloacal swabs; feces; feathers and tissue samples) can be collected, analyzed or archived for diet studies, genetics, isotope research, ecotoxicology, disease evaluation, histology and pathology.

CONCLUSIONS

The impacts of oil spills and chronic oil pollution on marine birds continue to be a major detriment to the health of local seabird populations. At a global level, oil contamination is likely contributing to regional declines in seabird populations (Burger & Fry 1993). Increasingly, oil spill response and natural resource damage assessments incorporate advanced scientific methods, but seabird impacts attributable to chronic oil pollution are rarely addressed with similar rigor. Lacking protocols for recovering and evaluating oiled birds that are not associated with major oil spill events, beached bird programs serve as valuable monitoring programs but rarely produce changes in policy or regulation that would benefit seabirds and marine ecosystems.

To improve our response to chronic oil pollution, to coordinate efforts of beachcast monitoring programs, and to better evaluate the full spectrum of morbidity and mortality factors in seabirds, we propose the development of an international seabird surveillance network. Such a program would benefit seabird conservation by increasing our awareness of the effects on seabird populations of emerging infectious diseases, ecotoxins and other health threats. It would also galvanize efforts to address chronic oil pollution by providing an opportunity to glean scientific information from

injured live birds in addition to beachcast dead birds. The ultimate goal of a coordinated network would be to collect samples for scientific research and to disseminate information, benefiting global seabird conservation efforts.

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