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OIL CONTAMINATION OF OSPREY (*PANDION HALIAETUS*) IN THE MEDITERRANEAN SEA: AN UNDERESTIMATED THREAT FOR THE SPECIES?

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Oil pollution may have deleterious effects on wildlife, and represents one of the most severe threats to marine birds and shorebirds that come in close contact with the source of contamination (Ronconi et al. 2015). Risks can arise during unpredictable disasters, such as accidental oil spills or gas platform failures (Kerr et al. 2010), or via exposure to chronic pollution. Oil pollution may also come from day-to-day operations such as discharges of oil from boats, which create oil slicks on the water surface. Piscivorous birds can be indirectly affected by the presence of oil slicks on the water surface, which may limit prey detection, resulting in less-efficient foraging. In addition, birds may be exposed to petroleum-derived products present in the fish prey they ingest. Oil contamination compromises feathers' structure and flight capacity, which can cause immediate death or can induce subsequent lethal effects due to inefficient thermoregulation (O'Hara and Morandin 2010, Whitmer et al. 2018). Negative effects of oil contamination occur in both the short and medium-long term, with ensuing consequences at the individual- or population-level, e.g., when entire seabird colonies are affected by pollution, causing deaths of thousands of individuals (Wilhelm et al. 2007).

Compared to seabirds, few accounts of oil contamination exist for raptors. However, in particular circumstances, oil contamination can represent a serious problem, especially in sensitive areas subject to chronic pollution (Clark and Gorney 1987). For example, a study conducted at one of the largest raptor migration locations in the world (Elat, Israel) showed that 5.2% of 1052 captured individuals (55 individuals of nine raptor species) were contaminated with oil-based products (Clark and Gorney 1987). In that study, birds were exposed to the contaminants while drinking water from pools with oil slicks on the surface. As a result, most birds were extensively contaminated and

succumbed to the effects of ingested oil (Clark and Gorney 1987).

As a general pattern, birds of prey are little affected by oil contamination at sea, as they rarely tend to live in strict association with the marine environment and/or forage at sea. Among raptor species, the Osprey (*Pandion haliaetus*) is an exception because of its unique ecology and behavior (Poole 2019): this species feeds exclusively on live fish at or near the surface of water bodies, and its life cycle is tightly linked to aquatic environments, as it is an apex predator of aquatic food webs. Moreover, it is often used as a biosentinel species, sensitive to environmental contaminants (Grove et al. 2009). The foraging strategy of the Osprey is to dive into the water to capture fish living close to the water surface (0–2 m deep; Poole 2019). This behavior makes the Osprey highly vulnerable to oiling and, in terms of exposure to potential risks derived from oil contamination at sea, makes it more similar to certain waterbirds (e.g., gulls, cormorants; Balseiro et al. 2005) than to other raptor species.

Records of oiled Osprey have been reported at inland waters in USA (e.g., in relation to a break in a fuel pipeline; McGowan 2001) and in the Red Sea (Heathcote et al. 1983). For the Western Palearctic and Africa, there are only 10 instances of ringed Ospreys that were reported oiled when encountered (of a total 11,257 encountered Ospreys (0.088%; EURING data base from 1906 to 2014). All were migratory Ospreys breeding in northern Europe. Among these, four were found in the Sahara desert, one in a coastal area of Mauritania and two at inland locations of central/eastern Europe (Table 1). The remaining three Ospreys were found in the Mediterranean region, two in central Italy and one in Malta. The last was the only one recovered at sea (Table 1). In the Mediterranean region, relict and vulnerable Osprey populations (i.e., <80–100 breeding pairs) are distributed among Algeria, Morocco, Corsica (France), Spain, Portugal, and Italy (Monti et al. 2018b). Beyond local birds, thousands of Ospreys migrate between breeding areas in northern and central Europe and wintering grounds in sub-Saharan areas twice each year, flying and stopping over across the Mediterranean region

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Table 1. European encounter records of Ospreys reported as oiled when encountered. Data from the EURING Data Bank. Condition of the bird, straight-line distance from ringing location and time elapsed between ringing and encounter also shown.

ORIGINAL								
RINGING SITE	RING CODE	ENCOUNTER DATE	COUNTRY OF ENCOUNTER	LATITUDE	LONGITUDE	CONDITION	DISTANCE (km)	ELAPSED TIME (d)
Finland	M008511	19 October 1976	Romania	46.1667	21.3333	Unknown	1781	821
Finland	M016777	17 May 1984	Italy	40.4	17.55	Found unhealthy	2542	685
Finland	M020559	21 May 1986	Italy	42.2667	14	Found unhealthy	2415	680
Sweden	9236259	12 October 1987	Tunisia	31.9167	9.31667	Freshly dead	2938	113
Finland	M019549	28 March 1988	Malta	35.8333	14.55	Freshly dead	2831	988
Finland	M039396	24 June 1998	Algeria	32	5.26667	Freshly dead	3490	351
Finland	M029432	1 May 1999	Germany	47.7	12.5333	Freshly dead	1797	3210
Sweden	9259711	1 April 2001	Algeria	28.6667	8.8333	Freshly dead	4335	986
Sweden	9285574	8 October 2010	Libya	28.1167	21.4	Freshly dead	3560	96
UK	1421596	22 September 2011	Mauritania	20.7667	-17.0333	Not freshly dead	4061	790

(Poole 2019). As a semi-closed basin surrounded by some of the most industrialized and heavily populated countries of the world, the Mediterranean Sea has alarming levels of contamination (Danovaro 2003). The large amount of maritime transport exposes its waters and shores to the danger of oil spills and accidental dissemination of other harmful and toxic chemicals from ships and vessels (Malta Environment & Planning Authority 2010), with potential impacts on the marine ecosystem and its biodiversity (National Audit Office Malta 2014). Despite this, oil contamination seems to have had limited significance for the Osprey.

Here I report a recent case of oil contamination of an Osprey for the Mediterranean Sea. On the morning of the 29 March 2019 at about 0830 H, an Osprey was observed on the south-facing cliff of the Cominotto Island (36.012833, 14.320433; Malta; Fig. 1a, 1b), during an inspection of the cliffs via drone. The bird was perched at a height of approximately 10 masl and showed clear signs of recent oil contamination (Fig. 1c). The Osprey was filmed at a minimum distance of 5 m using a drone (Mavic 2 Zoom, DJI™, Shenzhen, China) with an incorporated Mavic 2 Zoom camera, powered by a 42.3-mm 12 megapixel sensor with a 4× zoom, including a 2× optical zoom (24–48 mm). The video resolution was 1080p, with 25 frames per second. Although these features allowed a high-quality video, it was not possible to bring the drone close enough to read the metal ring code (partially soiled) on the right leg of the bird. The Osprey's feathers appeared to be freshly oiled. The oil contamination was visible on the feet, legs, bill, and upper breast feathers, as well as on the underparts and underwings (Fig. 1c). In addition, the face was also oiled, with the sole exception of a small section of feathers on the upper part of the head (Fig. 1c). During the recording of the video, the Osprey shook its head three times consecutively, presumably in an effort to remove oil from its bill. In a study on North American Ospreys, birds were

deemed “moderately” oiled when their underside, from legs to neck, was darkened by contact with oil (McGowan 2001). In this case, the extent of contamination was even broader, with the nearly all of the body covered by oil. The Osprey probably became contaminated by diving into the water and through an oil slick covering the water surface. I do not believe the Osprey was contaminated while drinking at a pond, because the extensive oiling does not match the description of raptors contaminated through drinking. As previously described for other raptor species (Clark and Gorney 1987), if the drinking raptor put its head in the oil slick in search of clear water, the resulting contamination would cover only the face and upper breast. On the contrary, a raptor bathing or diving in oil-covered water would potentially expose its entire body to oil, resulting in nearly complete contamination that would be widespread over many of the body, wing, and tail feathers (Clark and Gorney 1987), as in this case. Despite being approached by the drone at a distance of 5 m, the bird did not fly, but remained perched on the cliff for the entire duration of the drone flight (i.e., 3 min and 20 sec). Several hours later, at noon, the drone was sent again to film the place where the bird had been, but the Osprey was not detected there or on the surrounding cliffs surveyed by the drone (S. Vella pers. comm.).

The wet plumage of the bird (as seen in Fig. 1c), combined with the fresh and extensive oil layer on the ocean's surface, suggests the Osprey had recently dived into the water nearby. In fact, the oil would take some time to dry on bird feathers via evaporation of the volatile elements (Whitmer et al. 2018). Second, the high percentage of the body covered in oil would not have allowed the Osprey to undertake long flights, especially over the sea. The Osprey is not a breeding species in Malta, but Afro-Palaearctic migratory Ospreys commonly cross the island, during both autumn and spring migration to and from northern countries (BirdLife International 2010). The distance from

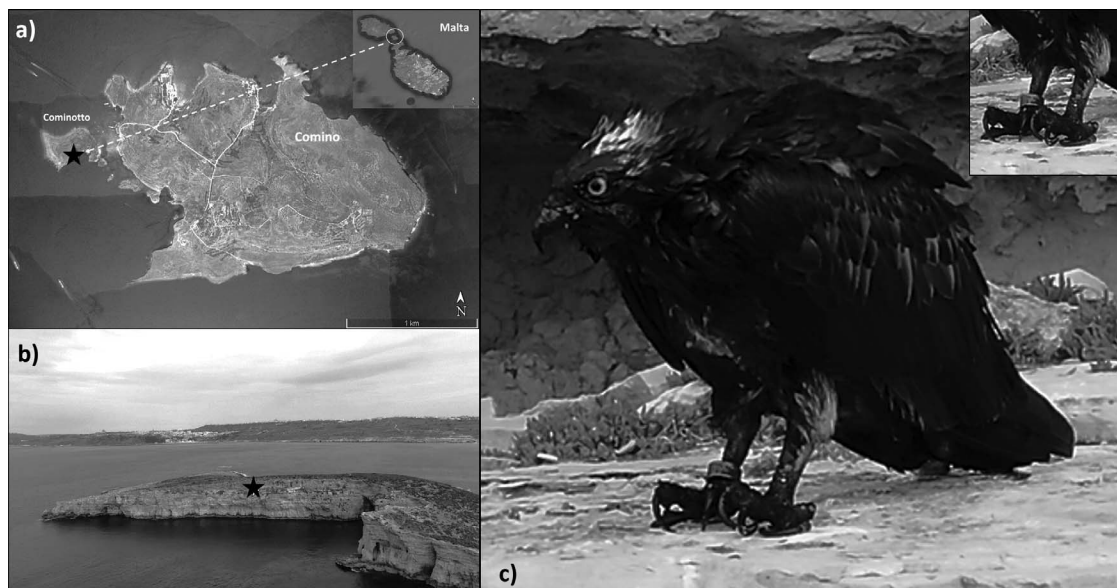


Figure 1. (a) Aerial image of the island of Cominotto (Malta), with star symbol indicating the place where the Osprey was observed; (b) view of the south-facing cliff of Cominotto Island and of the point where the Osprey was perched (star symbol); (c) the oil-contaminated Osprey, with inset showing the ringed leg, extracted from the drone's video record. Photo courtesy of Saveriu Vella.

the observation site to the coast of northern Africa is approximately 295 km, so it seems unlikely the Osprey flew this distance nonstop when contaminated with oil. Moreover, the shortest distance from the southern coast of Sicily was approximately 80–85 km from the observation site, which likewise suggests that contamination near Sicily and subsequent flight from Sicily was unlikely. Unlike seabirds, Ospreys do not forage far offshore; they cannot land or float on the water, so their feeding home range can be extremely small and largely confined to coastal areas or inland wetlands, river and/or ponds (Monti et al. 2018a). Thus, a local source of contamination was most plausible, although the oil slick may have originated elsewhere and been subsequently transported by sea currents. Furthermore, I assume that the bird did not survive this oiling. Even if it had been able to recover temporarily, such extensive contamination would likely be ingested when the bird preened, thus increasing the risk of adverse effects and death.

Because Ospreys can migrate far from the coast and can fly hundreds of km over the open sea (Duriez et al. 2018), potential cases of contamination and death from oiling may go undetected. Also, individual unmarked animals that have been found oiled might not be recorded in any official database, and might be forgotten. Thus, oil contamination in the marine environment could represent an underestimated cause of mortality for Ospreys.

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