Experiments to Determine Drift Patterns and Rates of Recovery of Sea Otter Carcasses Following the Exxon Valdez Oil Spill

Marine Mammal Study 6

Final Report

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EXECUTIVE SUMMARY

We conducted two experiments to determine recoverability and drift patterns of sea otter (Enhydra lutris) carcasses. One study conducted to assess carcass recoverability near northern Kodiak Island during the *Exxon Valdez* oil spill (27 May-3 June 1989) resulted in recoverary of 5 of 25 (20%) marked carcasses.

Thirty radio-monitored floats designed to assess the drift characteristics of floating sea otter carcasses were deployed in early summer 1990. Twenty-seven (83%) were known to have washed ashore, 25 in Prince William Sound (PWS) and 2 on the Gulf of Alaska coast of Montague during a 43 day monitoring period. Contact was lost with 2 (13%) of the floats, despite extensive searches throughout PWS and the Kenai Peninsula.

These studies do not address the following factors influencing the recoverability of sea otters dying as a result of the *Exxon Valdez* oil spill: 1) drift patterns of carcasses in heavy oil; 2) the proportion of sea otter carcasses sinking, 3) the persistence of floating and beach-cast sea otter carcasses, and 4) the behavior of oiled sea otters prior to death in nearshore and offshore areas.

Key words: carcass recovery, drift, Enhydra lutris, sea otter

INTRODUCTION

During the Exxon Valdez oil spill (30 March through 15 September 1989) beach clean-up and wildlife rescue crews collected marine mammal and bird carcasses. Carcasses were labeled with the date, area recovered and species and were stored in collection centers in Valdez, Seward, Homer or Kodiak. A total of 871 sea otter carcasses were collected throughout the oil spill area and of these, 493 were collected in Prince William Sound (PWS), 181 from the Kenai peninsula, and 197 from the Kodiak archipelago and Alaska peninsula.

After determining the number of sea otter carcasses recovered in the oil spill area, the next step was to estimate the actual number of sea otters lost from the population. To help estimate the number of sea otters killed, we conducted a study to assess the recoverability of marked sea otter carcasses near northern Kodiak Island during late May and early June of 1989 in areas frequented by beach clean-up crews and wildlife rescue personnel. To assess drift patterns and movement rates of floating sea otter carcasses originating in coastal areas of Prince William Sound we designed a simple drift study.

OBJECTIVES

1. Assess the recoverability of marked and unmarked sea otter carcasses by beach survey methods.

2. Determine whether simulated sea otter carcasses (floats) deployed in Prince William Sound remained in or drifted out of the Sound.

METHODS

Carcass Recovery

Twenty-five sea otter carcasses were removed from collection centers at Kodiak (n=10) and Homer (n=15). All carcasses were intact but one (missing head). Each carcass was tagged with a white Temple tag (Temple Tag Co.) on the hind flipper prior to release. We released carcasses in waters of northern Kodiak, Raspberry and southern Afognak islands including Raspberry Strait, between the western end of Kupreanof Strait and Anton Larson Bay. Specific release sites coincided with known areas of sea otter concentrations (DeGange and Monson, unpublished data). Ten (5 adult, 1 subadult, and 4 young-of-the-year) sea otter carcasses were released after thawing on 27 May 1989. State of decomposition varied from advanced to relatively fresh dead. Three of the carcasses were oiled. The 15 remaining carcasses were in various states of decomposition; 6 were oiled. On 1 June 1989, 9 frozen carcasses (7 adult, 1 subadult and 1 pup) were released. The remaining 6 carcasses were released on 3 June 1989. All carcasses were adult sized and were thawed or partially thawed at the time of release. Beach cleaning crews and individuals searching for oiled wildlife were prevalent in

the areas where the tagged carcasses were released. However, beach crews were not notified that marked carcasses were being released.

Drift Study

Floating, dead sea otters are generally found with head and tail submerged and only a portion of the rounded back exposed above the water surface. We constructed 30 floats designed to simulate floating sea otter carcasses. Each float was comprised of half of a 35-cm car tire with wood inserted centrally for flotation. The wood was bolted to the tire with threaded rod. A hole measuring approximately 1.9 cm in diameter was drilled in the tire above the wood block to allow trapped air to escape. This design allowed the float to be self-righting and have a relatively constant surface area exposed above water. Average weight of the floats was 6.6 kg (range 6.1-7.0 kg). The sides of each float were painted with fluorescent orange and each float was marked with white stenciled numbers. A radio transmitter (Advanced Telemetry Systems (ATS), Bethel MN), was affixed to each float. Transmitters weighed approximately 40 g and measured approximately 5x5x3.75 cm with an external wire whip antenna. Battery life of transmitters was 40 days, and transmitter pulse rates were 100 per minute. Transmitter range was estimated at 50 km from an altitude of 0.75 km. Floats remained low in the water, exposing approximately 2.5 cm of tread above the water

surface where the radio transmitter was attached. We believe the floats reasonably approximated floating dead sea otters.

We deployed the floats on 29 June and 12 July 1990 in western PWS in areas where sea otters were known to occur within the oil spill area (D. Burn 1990). Three areas (Applegate Rocks, Naked Island and Bay of Isles) were selected based on sea otter presence in 2 of 3 survey periods (July and August 1989 and March 1990) on transects surveyed in the oil spill area; sites with the highest abundance of sea otters were chosen. We limited our study areas by selecting surveyed areas originating 200 m or more off-shore. Five floats were deployed haphazardly in each of the three areas by float plane on 29 June 1990; 14 days later, an additional 5 floats were deployed haphazardly within each of these sites.

Floats were monitored daily, as weather conditions permitted, during the 40 day operational period of the radio transmitter or until the float remained fixed on a beach. Location, location quality, date, time and water surface conditions were recorded each time a float was relocated. We obtained wind speed and wind direction data from a remote weather station located on Seal Island, PWS; digital data was provided by National Weather Service, NOAA.

RESULTS

Carcass Recovery

Five adult sea otter carcasses (2 of the first and 3 of the second release) of the 25 tagged carcasses were recovered during the beach clean up and monitoring efforts, for a total recovery of 20%. Recovered tagged carcasses were obtained during 31 May - 11 June 1989. Three of the 5 were recovered as intact carcasses and the remaining 2 were partially scavenged.

Two sea otter carcasses (one thawed and the other frozen) may have sunk or floated below the water surface at the time of release and thus influenced their recoverability.

Drift Study

Floats were monitored from 29 June to 9 August 1990. Weather conditions allowed us to search for floats 22 days during this 43 day monitoring period.

Twenty-five of the 30 floats washed ashore on Prince William Sound beaches and 2 left the Sound and beached on Montague Island via Hinchinbrook Entrance during the monitoring period (Table 1). Of the remaining 3 floats whose fate was undetermined, 2 could not be found after 7 and 19 days, despite aerial searches in Prince William Sound and the Kenai peninsula. Failure rate for

this type of radio transmitter is generally < 3%, (ATS pers. comm.) It is possible that 1 or both of these floats had drifted out of the Sound and went undetected. The third float was likely ashore but the location was not verified. We received an intermittent signal from the transmitter when tracking at a low tide and believe this float may have been lodged in the intertidal zone preventing the detection of a radio signal during high tides when the radio was covered with salt water.

Mean number of days for floats from the 29 June and the 12 July release to wash ashore were 16 (range 7-33 days, n=13) and 13 (range 4-25 days, n=14) respectively (Table 1). Of the 27 floats known to have washed ashore, 22% refloated and washed ashore elsewhere.

Thirteen movement rates were estimated from 7 floats having 2 or more daily locations recorded (mean time between relocations 24 hrs). Average rate of movement was 8 km/day (range 2-21). Corresponding wind direction was variable, ranging from NNW to SSE, and average wind speed for this period was 10.4 km/hr (range 0.32-26.7 km/hr). The direction of travel for 6 of 13 float movements examined was within 45 degrees of the wind direction indicating current flow to be the dominant factor in their movement. Movement rates for 3 floats exposed to a constant wind direction of > 135 degrees to the direction of float movement averaged 1.6% of the wind speed. The remaining 4 float movements were erratic and appeared to have been influenced by both wind

and current vectors. Detailed vector analysis of float direction and movement rate was not possible because we lacked point specific data on water current, wind speed and wind direction for each relocation of the float.

The release site, approximate travel route and last location of all floats monitored are presented in Figures 1-6. Floats released in the same area at the same time exhibited very different movement patterns throughout the monitoring period. Similarly, floats released in the same geographic area at different times exhibited dissimilar movement patterns.

DISCUSSION

The recoverability of sea otter carcasses on beaches is influenced the proportion of carcasses sinking, beach persistence, and by the drift pattern of floating carcasses. Whether a sea otter carcass sinks or floats may be influenced by cause of death. Drowned sea otters tend to sink and otters which die acutely (ie, are shot) generally float (USFWS unpub. data). Carcasses (otter and bird) which have been frozen then thawed, tend to float low or sink when placed in water (Ford, pers. comm.). Persistence of intact beached carcasses in Prince William Sound may be as short as 3 days, however skeletal remains may persist longer and there may be considerable variation in the duration a scavenged carcass remains on the beach. Bald eagles

have been identified as one of the major scavengers on beach-cast sea otter carcasses (Johnson, pers. comm.).

We speculate that the drift patterns and movement rates of the floats deployed in clean salt water do not represent those of sea otter carcasses in a heavy oil slick. A drift rate of 3% of the wind speed has been used to model movement patterns of oil floating on the water surface (Tsahalis 1979, Galt and Payton (1990). We calculated a drift rate of 1.6% of the wind speed for 3 of the movement rates, but the effects of water currents were unknown. It is likely that drift characteristics of bird and mammal carcasses entrapped in heavy oil slicks were influence by the drift pattern of the oil. Sea otter and marine bird carcasses were observed in heavy oil which had formed windrows in offshore areas in Prince William Sound (Bodkin, Monnett pers. comm.). Galt and Payton (1990) estimated 25% of the oil spilled exited Prince William Sound and 10% traveled beyond Gore Point on the Kenai Peninsula; it is likely that some sea otter carcasses also drifted out of the Sound with the heavy oil.

Our best estimate of carcass recovery from the Exxon Valdez oil spill is generated from the tagged carcasses released near Kodiak Island. Because beach clean up and wildlife rescue crews routinely collected sea otter carcasses in the release area, the data can be compared to nonsystematic beach surveys. Non-systematic beach surveys were used in California to assess the recoverability of sea otters drowning in the set-net fishing

industry during 1982-84 (Bishop 1985; Wendell 1986). Drowned sea otters were recovered from fishing nets which were set off shore; carcasses were tagged and thrown back into the water. Mean annual recovery of tagged carcasses was 36% (n=12 sea otter carcasses) for years 1982, 1983 and 1984 (Wendell 1986).

CONCLUSIONS

In an area with intensive search effort, 20% of sea otter carcasses were found, which is slightly lower the recovery of marked sea otter carcasses reported in California. Based on drift patterns of the floats, a wide search area would be necessary to recover carcasses where heavy oil did not influence drift. Lack of information on 1) drift patterns of carcasses in heavy oil, 2) the proportion of sea otter carcasses sinking, 3) the persistence of floating and beach-cast sea otter carcasses, and 4) the behavior of oiled sea otters prior to death in nearshore and offshore areas, limited our ability to assess recovery rates of sea otter carcasses.

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Table 1. Fate of radio-tagged simulated sea otter carcasses deployed in Western Prince William Sound, Alaska on 29 June and 12 July 1990.

Release location	Release time	Identification number	Number relocations	Number of days prior to first beaching	Number of times beached and refloated	Final location or status in Prince William Sound
Applegate Rocks	29 June	5243	9	-	-	Missing - 16 July
		5373	9	7	0	N Montague Is.
		5413	7	33	0	Green Is.
		5740	12	17	0	Seal Is.
		5013	11	18	0	Ingot Is.
	12 July	4122	6	11	0	Bay of Isles
		4293	7	11	0	NW Montague Is.
		5084	5	7	0	Bay of Isles
		5324	9	19	0	Main Bay
		5343	5	10	0	Bay of Isles
Bay of Isles	29 June	5035	6	-	-	Missing - 5 July
		5104	11	19	0	Busby Is.
		5273	12	7	2	Smith Is.
		5703	12	19	0	Eaglet Is.
		5823	13	17	2	SW Montague Is.
	12 July	5393	6	4	0	Green Is.
		5554	6	19	0	Smith Is.
		5632	8	25	0	SE Montague Is.
		5785	6	25	0	SE Montague Is.
		5863	8	11	0	Seal Is.
Naked Island	29 June	5133	12	13	0	Applegate Is.
		5192	13	17	2	Perry Is.
		5223	14	7	2	Storey Is.
		5613	13	17	2	Hidden Cove
		5852	12	13	0	Perry Is.
	12 July	4180	9	4	2	Chenega Is.
		4233	3	-	-	Knight Is. Pass.
		4563	4	5	0	Bay of Isles
		4911	7	5	2	SW Montague Is.
		5760	5	20	0	Bay of Isles

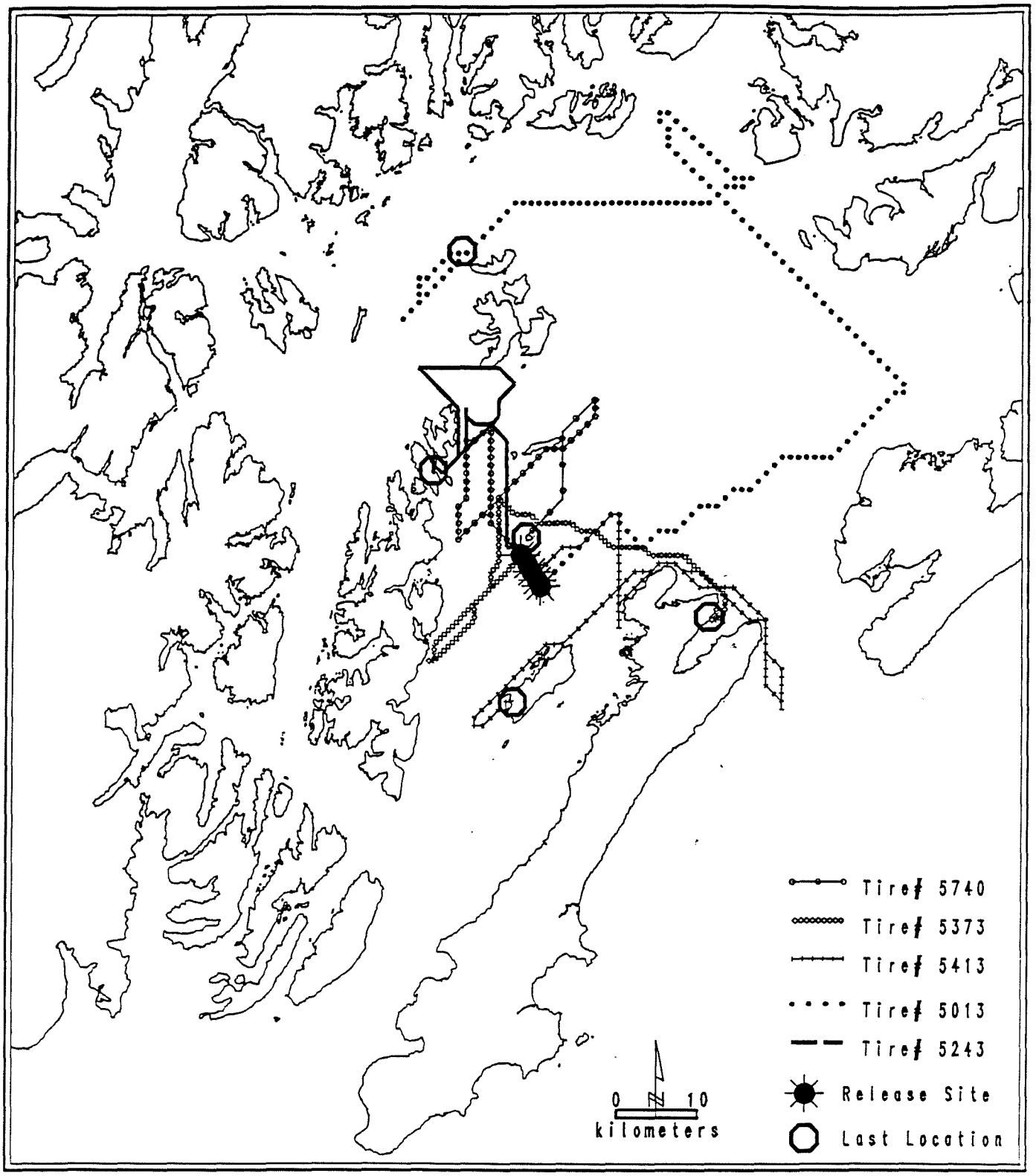

Figure 1. Drift patterns of five radio-tagged floats released 29 June 1990 near Applegate Rocks, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.

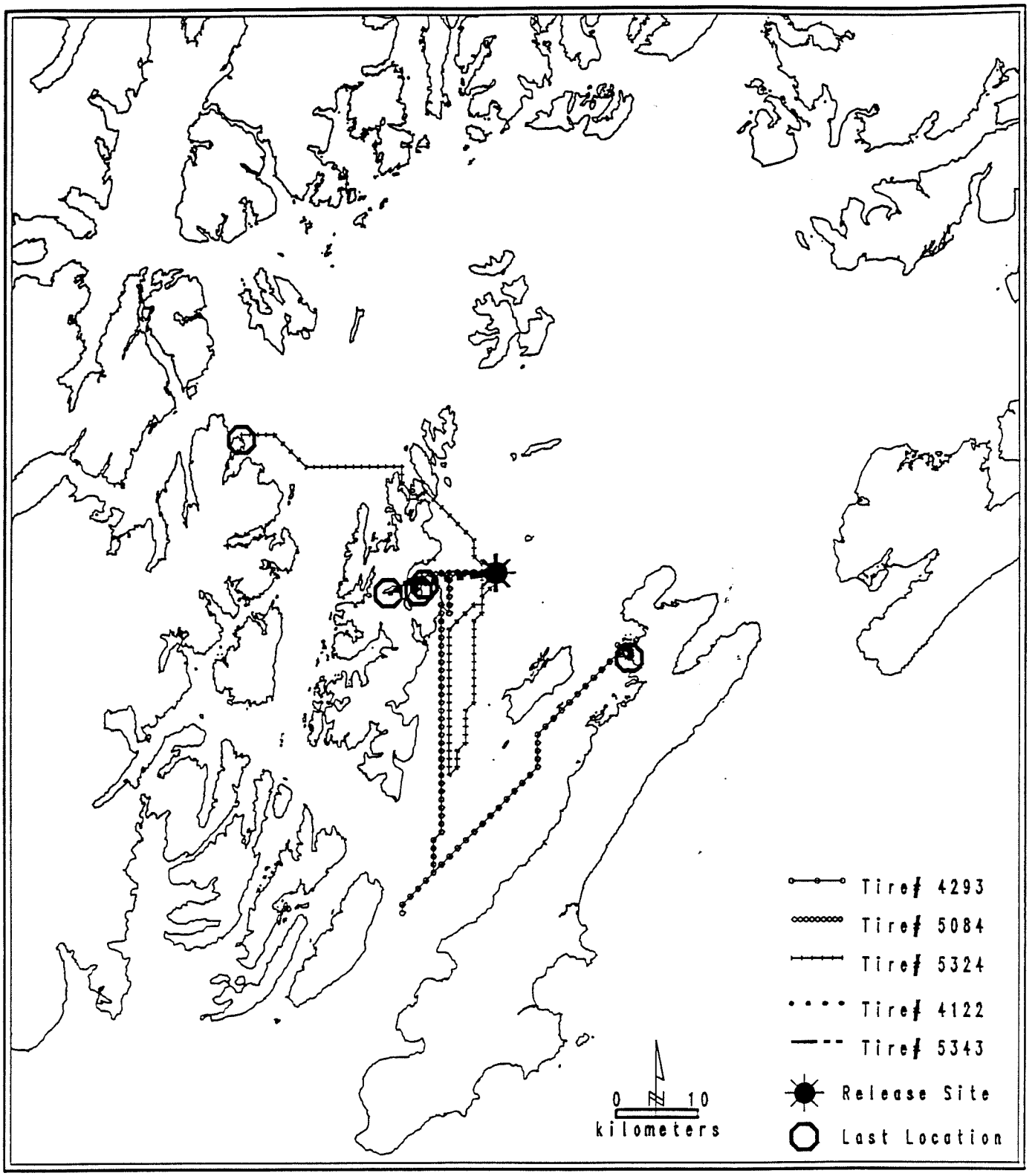

Figure 2. Drift patterns of five radio-tagged floats released 12 July 1990 near Applegate Rocks, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.

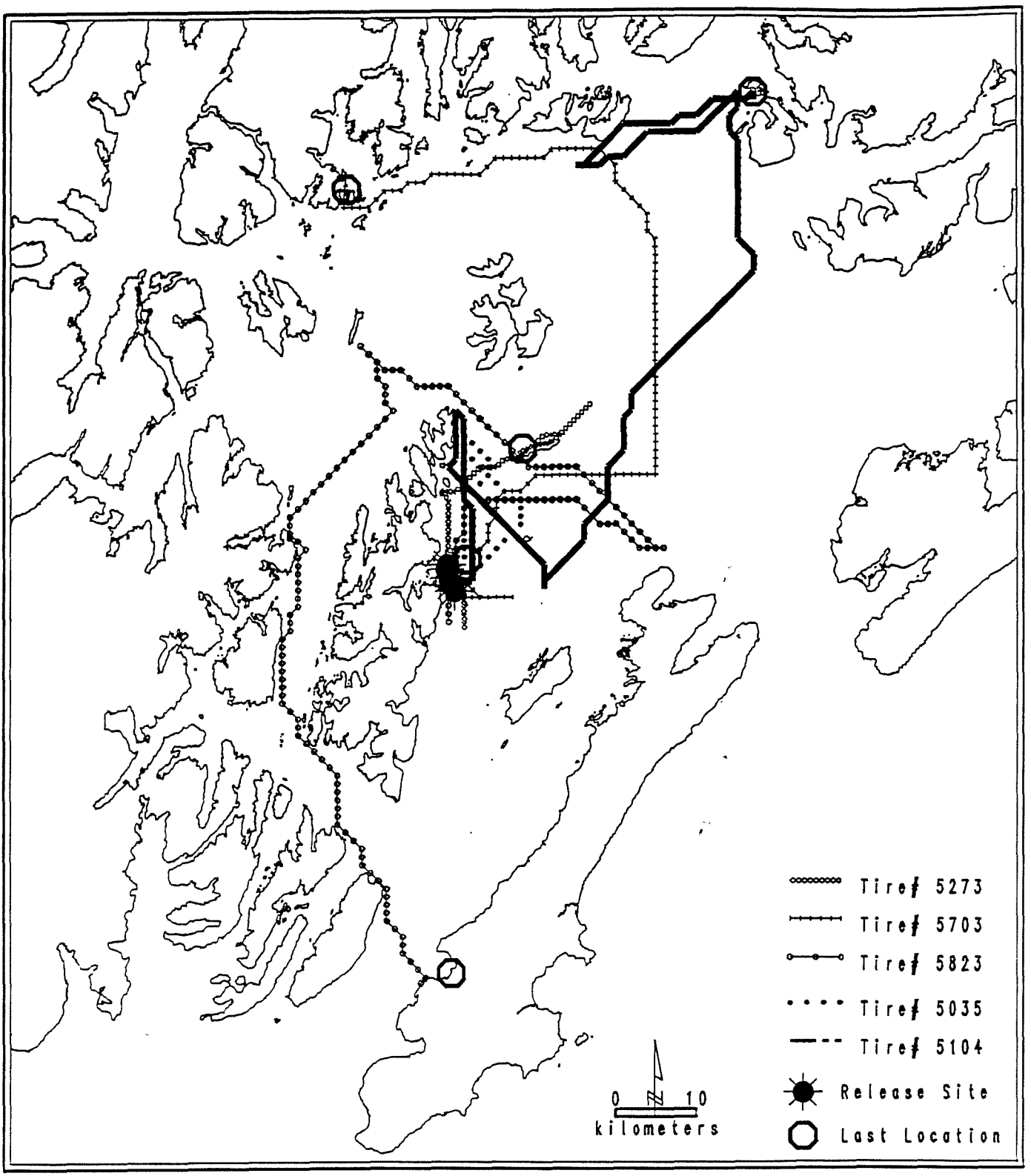

Figure 3. Drift patterns of five radio-tagged floats released 29 June 1990 near Bay of Isles, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.

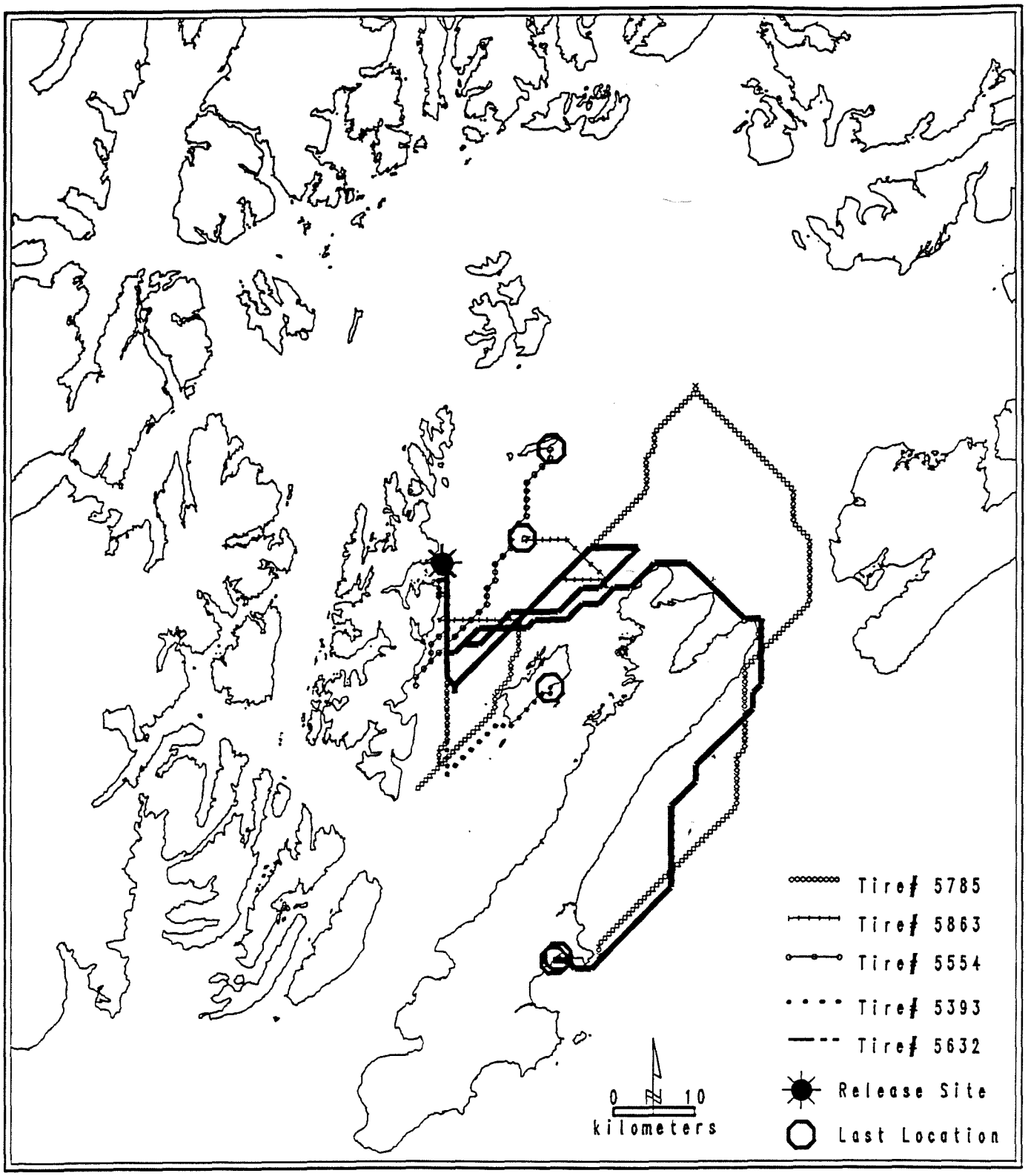

Figure 4. Drift patterns of five radio-tagged floats released 12 July 1990 near Bay of Isles, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.

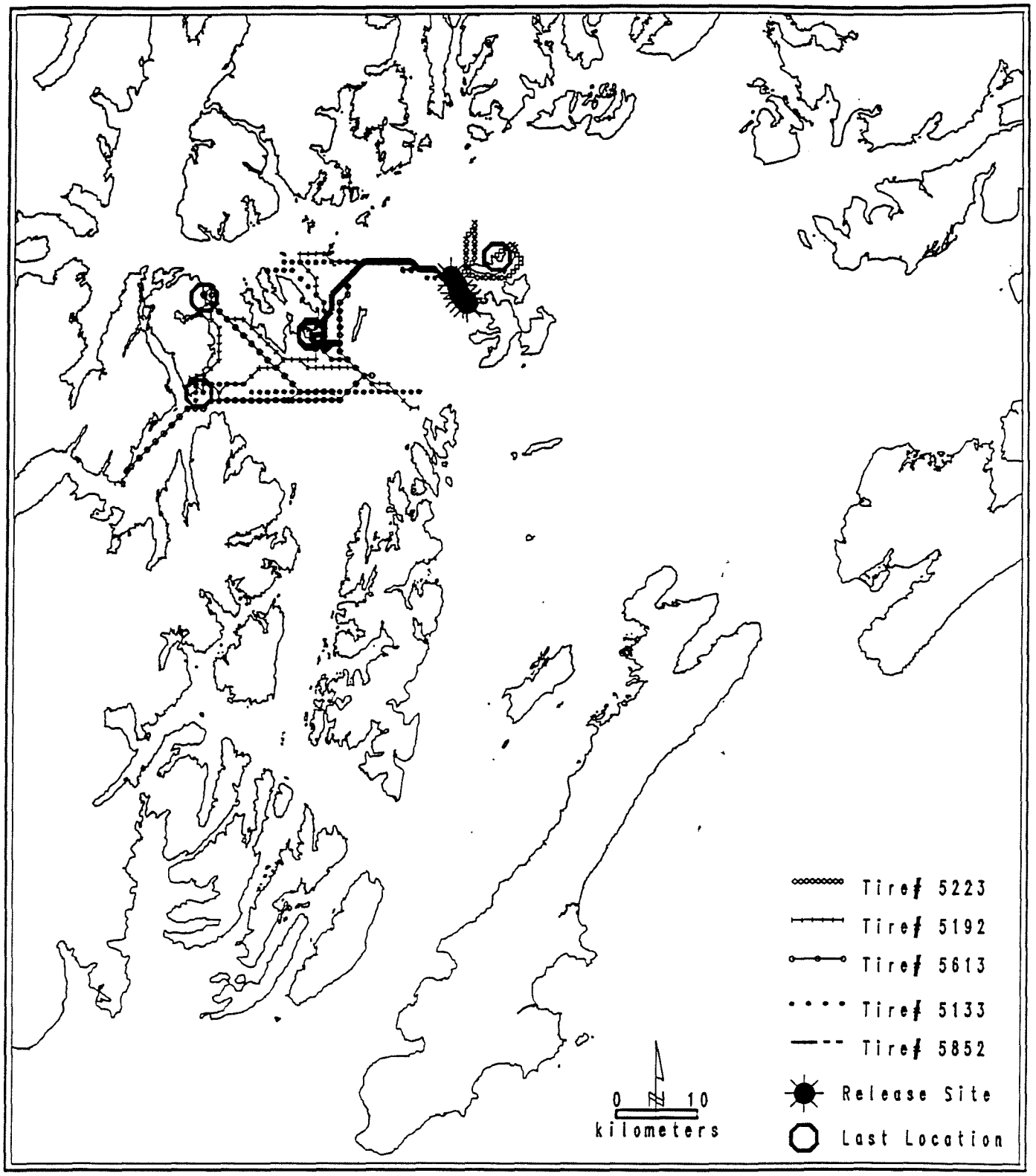

Figure 5. Drift patterns of five radio-tagged floats released 29 June 1990 near Naked Island, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.

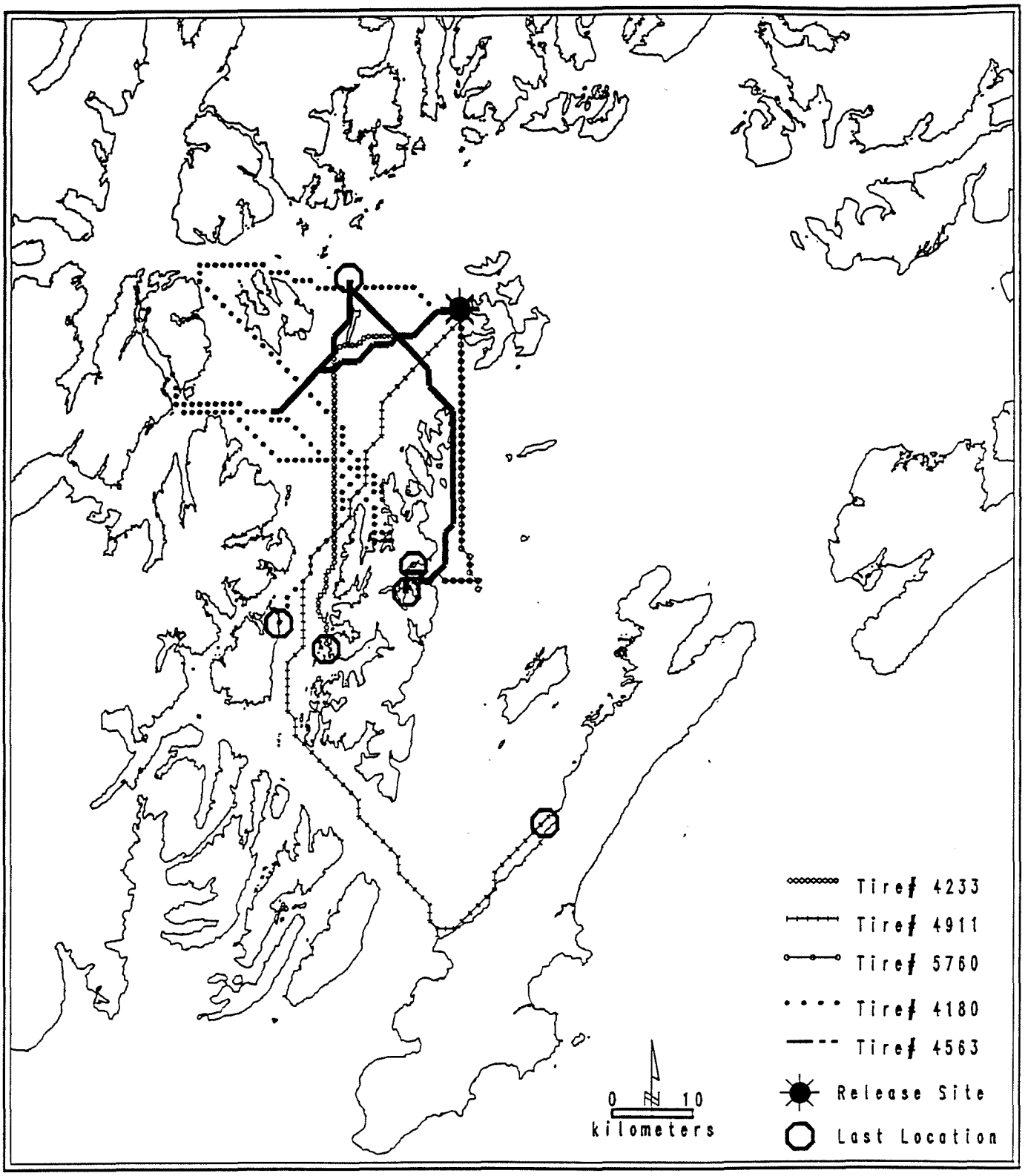

Figure 6. Drift patterns of five radio-tagged floats released 12 July 1990 near Naked Island, Prince William Sound, Alaska. The travel route between sequential relocations was synthesized by Network, a Geographic Information Systems program.