# Seaglider Observations During Summer 2000

C. C. Eriksen[1], R. D. Light[2], T. W. Lehman[1], T. Wen[2], M. J. Perry[3], A. M. Chiodi[1], P. L. Sabin[2], M. L. Welch[2], and N. M. Bogue[1]

[1]School of Oceanography, University of Washington, Box 357940, Seattle WA 98195-7940
[2]Applied Physics Laboratory, University of Washington, Box 355640, Seattle WA 98195-5640
[3]School of Marine Science, University of Maine, Darling Marine Ctr., Walpole ME 04573-3307

## Summary

Two major field deployments of Seagliders took place during summer 2000, a one-month single glider mission in Possession Sound, Washington, and a 3-glider mission in Monterey Bay, California. Over 1500 dive cycles were made in these demonstration experiments. All data as well as commands to the vehicles were telemetered via cellular telephone in near real time to and from remote fixed and mobile computers both ashore and aboard small vessels.

Seaglider #003 in Possession Sound was operated mostly in 'virtual mooring' mode by maintaining its position near 3 different targets in succession (Figure 1) from 21 June through 19 July 2000. In addition to holding its position against depth-averaged tidal currents as strong as 0.3 m/s and a mean surface current of 0.5 m/s, it routinely traversed waters whose potential densities differed by more than 10 kg/m$^3$, ranging from roughly half fresh water at the surface to water of nearly oceanic salinity at depth. The ability to estimate depth-averaged current from the difference between dead-reckoned and over-the-ground displacements was demonstrated, as well as the ability to collect time series of temperature and salinity profiles under remote control (Figure 2). Seaglider #003 glided over 200 nautical miles during its mission. Power usage confirmed that deployments in the deep ocean of several months duration and several thousand km range are feasible.

Three Seagliders were deployed together in Monterey Bay during the last half of August 2000. Seagliders #002 and #003 repeatedly occupied a 15 km long transect across the continental shelf, diving to within a few meters of the bottom or 250 m, whichever was shallower. These gliders typically stayed within a km of the track between successive targets (Figure 3) except during episodes of strong current. Each glider carried a coarse bathymetric map from which it decided how deep to dive based on position and desired course. The sequence of temperature and salinity sections collected illustrates the development and decay of a wind-forced surface mixed layer (Figure 4). Seaglider #004 was directed along a parallel transect ~10 km to the south, along the south rim of Monterey Canyon (Figure 5). In addition to a CTD, it carried oxygen and fluorescence sensors. Fluorescence was found to be strongest in the thermocline over the deep waters of the canyon, in marked contrast to adjacent waters over the continental shelf. A possible explanation is enhanced nutrient supply from mixing within the canyon.

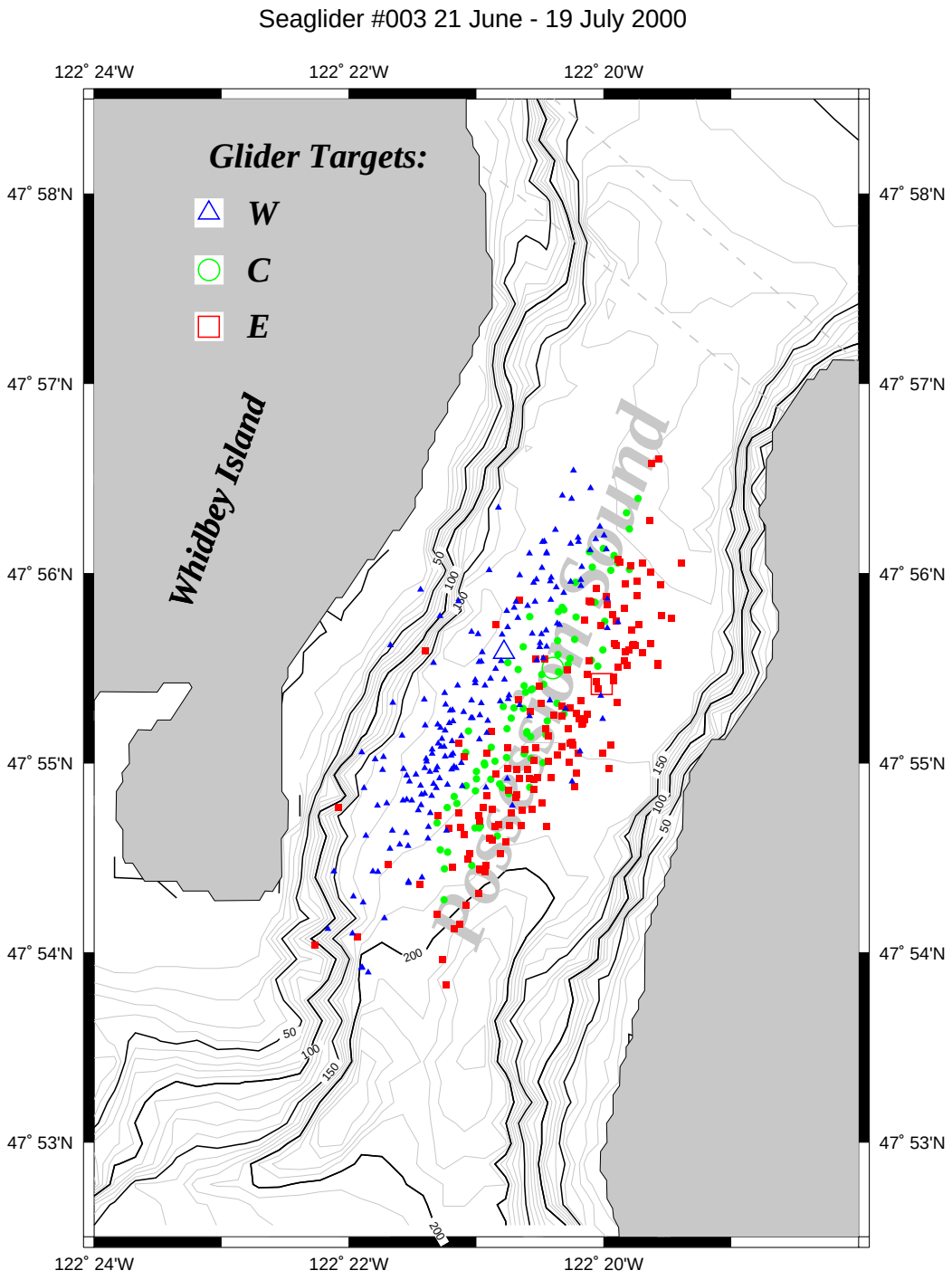


*Figure 1. Surface positions of Seaglider #003 in Possession Sound, Washington 21 June - 19 July 2000. Targets in the center and sides of the channel are given by open symbols. Scatter about the targets in the along-channel direction is due to imperfect prediction of currents by the glider navigation algorithm.*

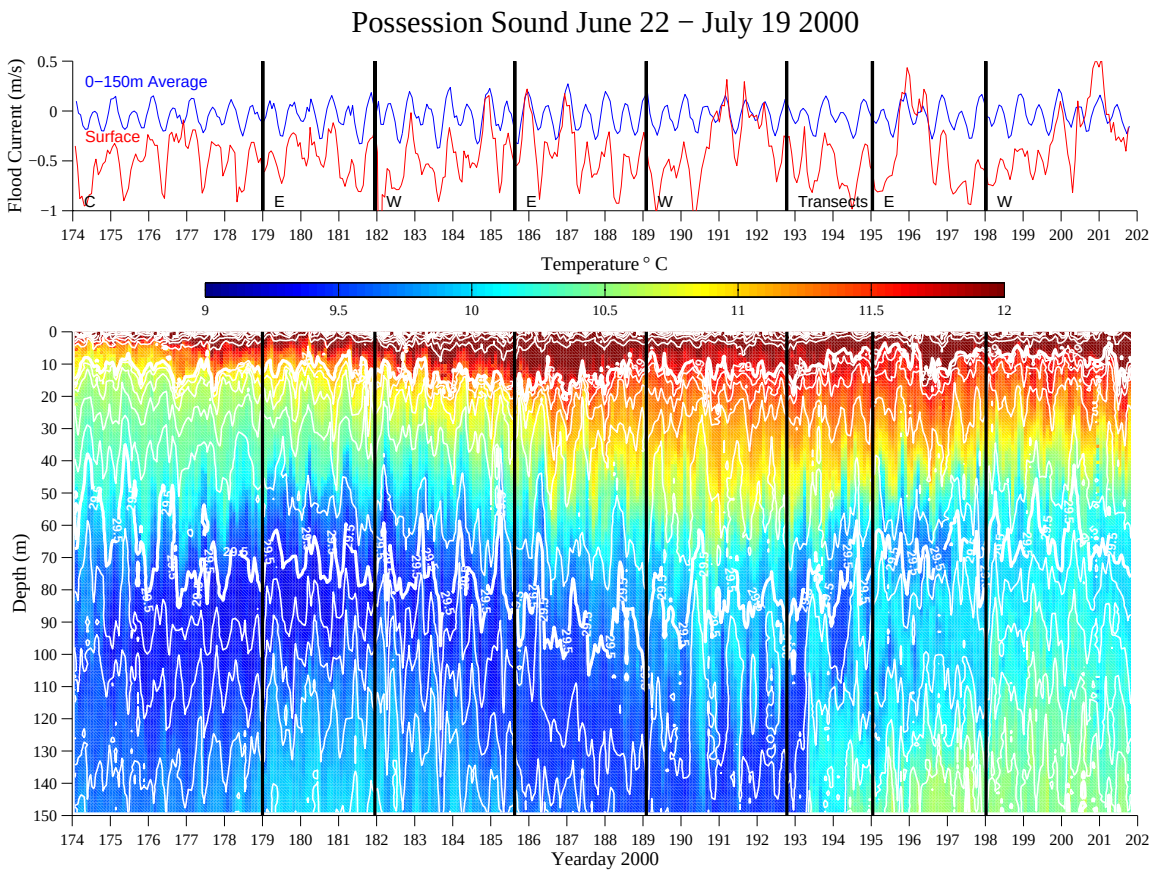


*Figure 2. Month-long depth-time section of temperature (color scale) and salinity (0.1 psu contour interval for salinities 29 psu and higher, 1 psu otherwise) from 446 dive cycles made by Seaglider #003 in Possession Sound, Washington from 22 June to 19 July 2000. Upper panel shows depth-averaged current (blue) inferred from the difference between glider dead-reckoned and GPS displacements on each dive cycle and surface current (red) inferred from the difference between successive GPS fixes bracketing communications activity via cellular telephony. Strong salinity stratification near the surface and consistent ebb (except during brief windy periods) characterize estuarine outflow driven by riverine forcing by the Skagit and Snohomish Rivers. Variations in deep temperature and salinity with roughly fortnightly period suggest circulation and mixing linked to the spring-neap tidal cycle.*

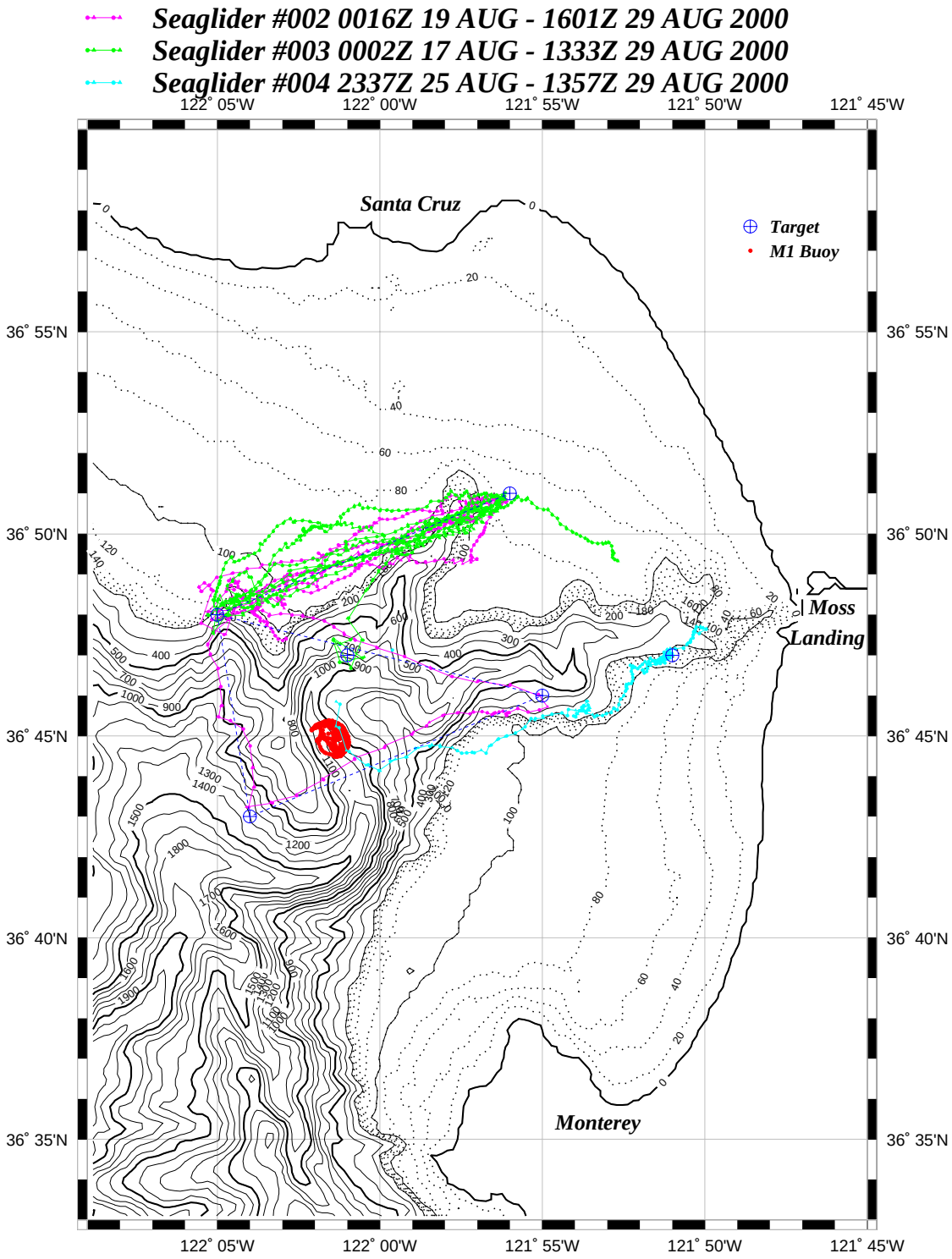


*Figure 3. Tracks of 3 Seagliders in Monterey Bay over 12.5 d depicted by two GPS fix locations made at the sea surface between each dive cycle. Seagliders were launched at various nearshore locations over the continental shelf and instructed to transit between waypoint targets indicated in blue. About 0.5 d before recovery, all three were instructed to head to the target at 36°47'N, 122°01'W. Red symbols indicate buoy positions of the M1 surface mooring maintained by MBARI. Depth contours are in m.*

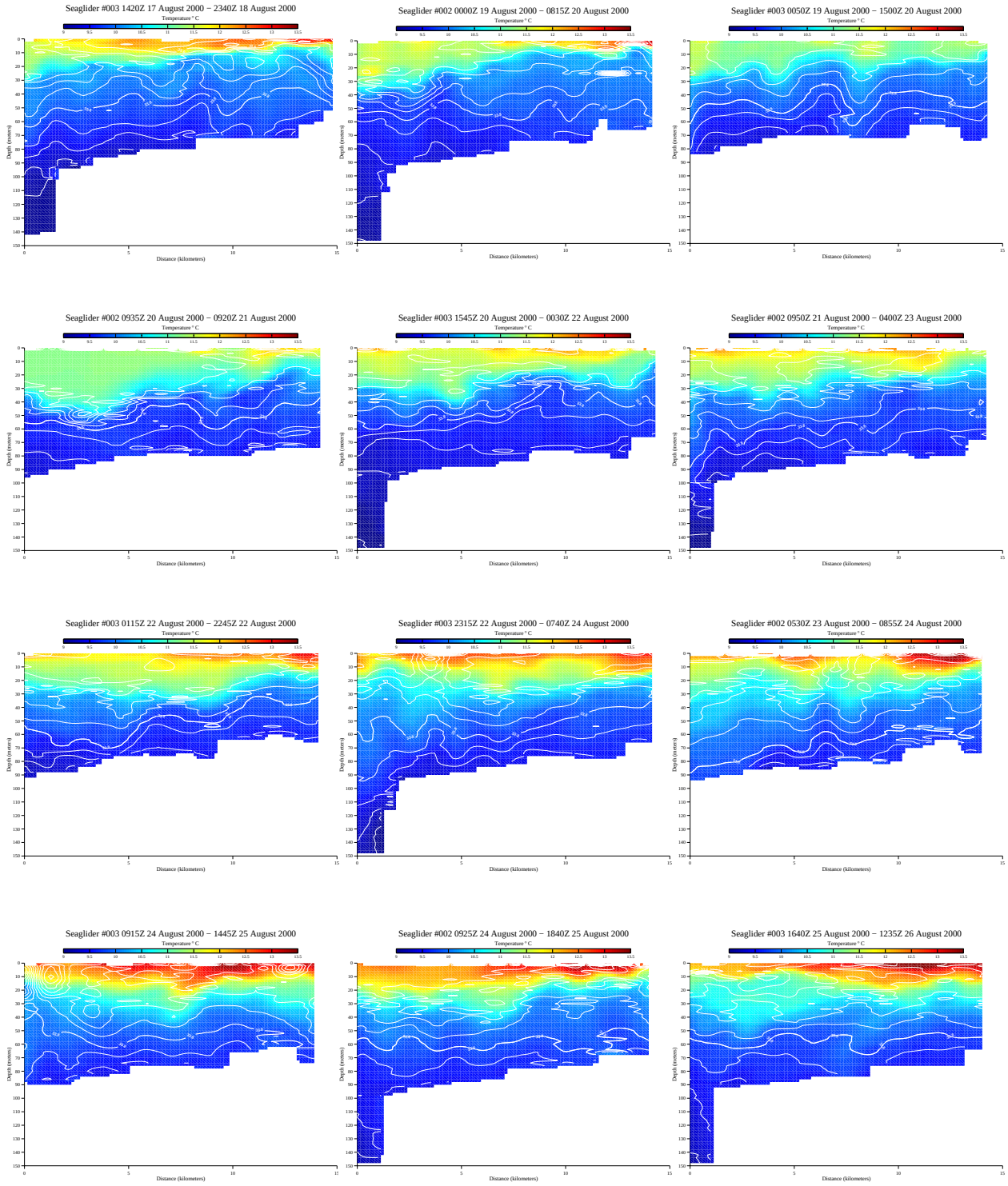


*Figure 4. Twelve 15 km long sections made from 17 to 26 August 2000 with Seagliders #002 and #003 across the continental shelf in central Monterey Bay. Positions are relative to 36°48'N, 122°05'W in the direction of 36°51'N, 121°56'W. Temperatures (9-13.5°C) are in color overlain with salinity contours (interval 0.04 psu). The time sequence of sections is across each row from left to right starting at the top left. Note the formation of a surface mixed layer 30-40 m thick in the third and fourth sections (due to upwelling favorable winds in excess of 20 kt on 19 and 20 August) followed by restratification in subsequent sections (when winds were weaker).*

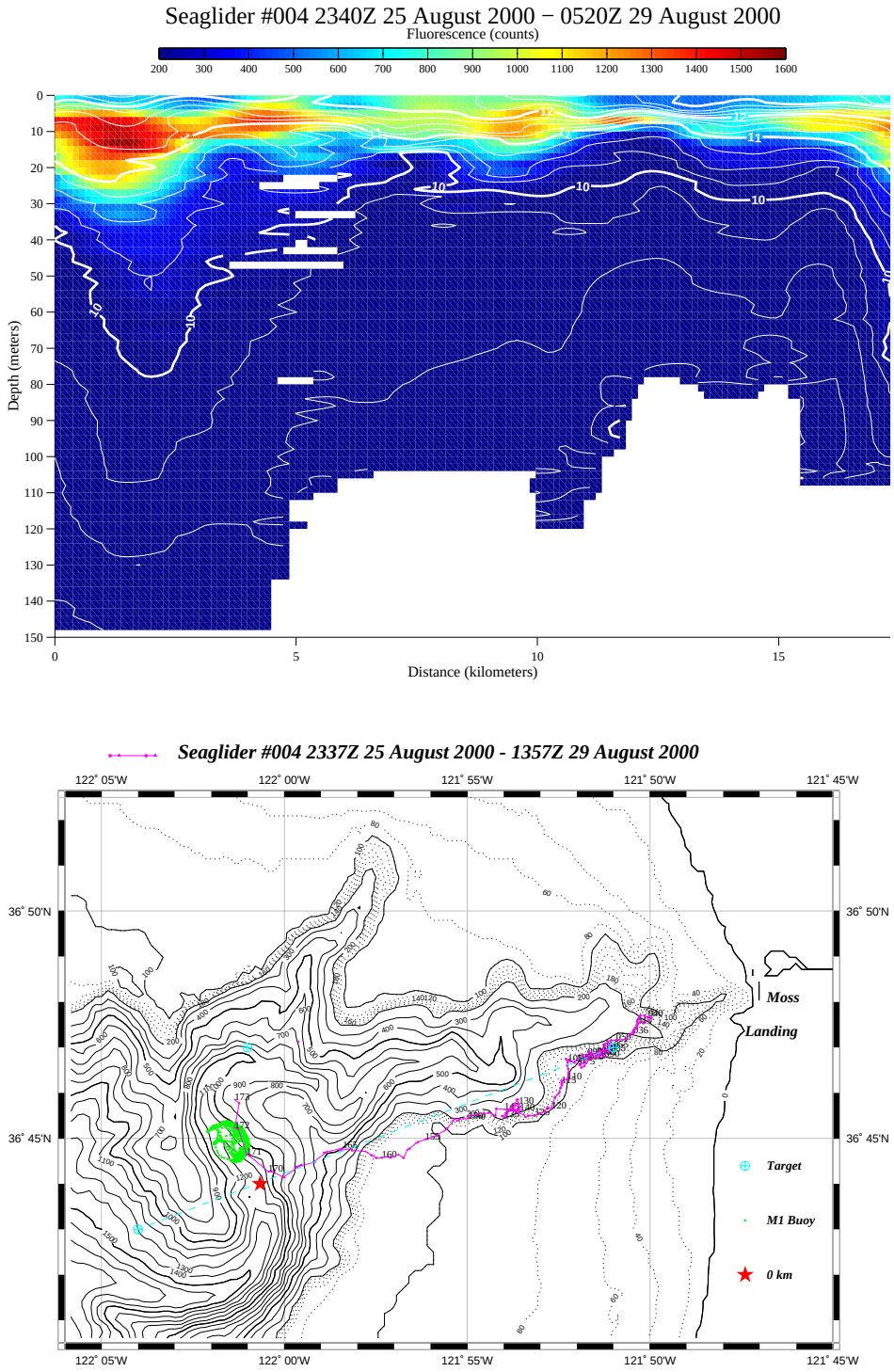


*Figure 5. Lower panel: Track of Seaglider #004 over 3.5 d. It was launched near the head of Monterey Canyon and travelled toward targets along a transect near the south rim of the canyon befor being sent toward a target in mid-canyon for recovery. Upper panel: Flourescence (color, arbitrary units) and temperature (white contours, interval 0.2°C) mapped along 69°T bearing from 36°44'N, 122°0.67'W (indicated in the lower panel by a red star where 69°T is shoreward along the dashed cyan line). Note fluorescence is highest in the thermocline and is strongest over water deeper than ~200m, perhaps due to increased nutrient supply from mixing within the canyon.*