Habitat use of black turtles (Chelonia mydas) in San Ignacio lagoon, Mexico

Jesse Senko[1], Volker Koch[2], William Megill[3]

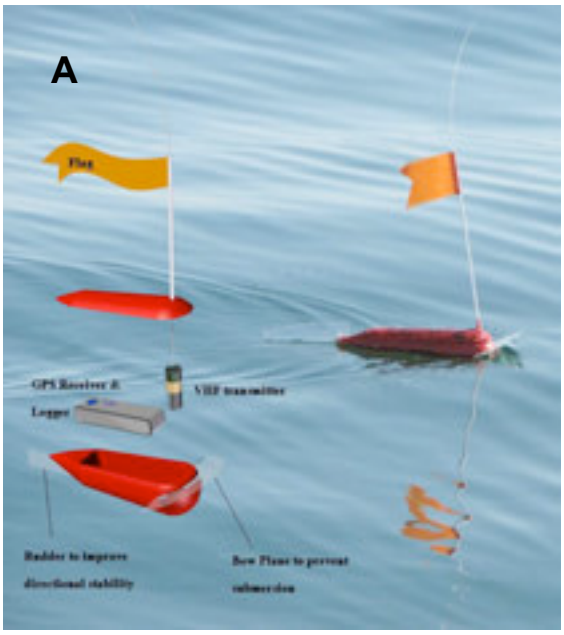
[1]University of Florida, Gainesville, FL, USA, [2]Universidad Autónoma de Baja California Sur, La Paz, BCS, Mexico; [3]University of Bath, Bath, England, U;

Introduction San Ignacio Lagoon is part of the El Vizcaino Biosphere Reserve. The lagoon is shallow, protected, and serves as an important feeding and developmental area for the east Pacific green or black turtle, *Chelonia mydas* (Nichols 2003), which is currently listed as endangered (IUCN 2004). Black turtles, like most sea turtles, utilize several different habitats within their lifetime (Hirth 1997, Nichols 2003). Arguably the most important habitats for black turtles are neritic foraging areas where juveniles may spend 20 years or more (Seminoff et al. 2002a, Koch et al. 2007) until they reach maturity (Nichols 2003). Although recent studies (Seminoff et al. 2002b, Brooks 2005, Seminoff and Jones 2006) have provided a framework for spatial ecology of black turtles on their foraging areas, little detailed information is available regarding habitat use and movement patterns on a fine scale. Understanding the spatial requirements of black/green turtles during this critical life stage is fundamental to their conservation (Bjorndal 1997, Nichols 2003). Here we report preliminary results on the fine scale movement and activity patterns of immature black turtles and provide future research goals, objectives, and initiatives.

Study area. The study commenced in November 2007 at San Ignacio Lagoon. The area is located on the eastern Pacific Ocean within the 2.5 million ha El Vizcaino Biosphere Reserve and has a surface area of approximately 17,500 ha. The lagoon is a highly productive coastal ecosystem that is heavily influenced by tidal currents. Mean depth is < 5 m and the area has extensive eelgrass and algae beds (Nichols 2003).

Figure 1: Map of the study area

Turtle Capture and Measurement. Immature black turtles were captured using entanglement nets (100 x 8 m, mesh size = 50 cm stretched). Captured turtles were able to surface and breathe as the nets contain little weight on the lead line. We set nets in shallow regions at slack tides during both day and night and monitored them regularly (≤ 1 hour). Upon capture, turtles were measured, weighed and tagged at the closest landing. Most animals (90%) were held 1-2 hrs and no turtles were kept > 5 hrs.



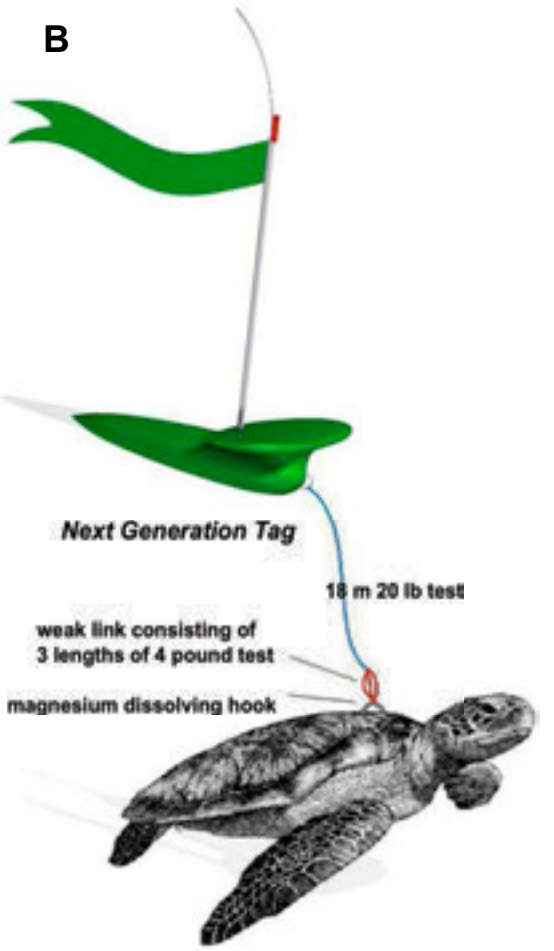


Figure 2: Experimental setup
Top left (A): Annotated diagram of floating buoy with components used during November 07 season.
Top right (B): Setup for the 2008 season using a different tag design and release mechanism.
Bottom (C): GPS receiver and data logger alongside VHF transmitter sealed in a

Tracking. We tracked immature black turtles using VHF (148.103 – 148.146 MHz) telemetry and GPS. The tracking unit consisted of a self-righting floating buoy (22 x 5 cm; 200 g total package; ≤ 1% of turtle body mass) made out of Styrofoam, a monofilament floating line (18 m length, 20-pound test) as a tether, a weak link (4-pound test) and a carapace attachment point (see figure). The attachment point was glued to the middle of the first central scute using 5 minute quick set epoxy. We placed a small GPS (Trackstick) receiver and data logger (10.3 x 2.8 cm) sealed in a condom and a VHF transmitter inside the floating buoy. We configured the GPS device to receive and record locations (± 3 m) every 15 seconds. All Instrumented turtles were released from shore at Kuyima Ecotourism Camp. We used a Yagi antenna (Advanced Telemetry Systems; Isanti, MN) to locate the buoys in order to change batteries and download the GPS data every 12-24 hours. We triangulated positions from shore every two hours to maintain contact with turtles during unsupervised periods. Tracking was terminated when the tether broke or, if still attached after 96 hours, the unit was removed by pulling the tether until it snapped at the weak link.

Statistical analysis. We mapped and analyzed tracks using LabView Software and Excel. In the future we plan on using ArcView 3.2 GIS Animal Extension software while partitioning tracks into diurnal (0500 – 1859 h) and nocturnal (1900 – 0459 h) periods as well as between tidal cycles.

Results

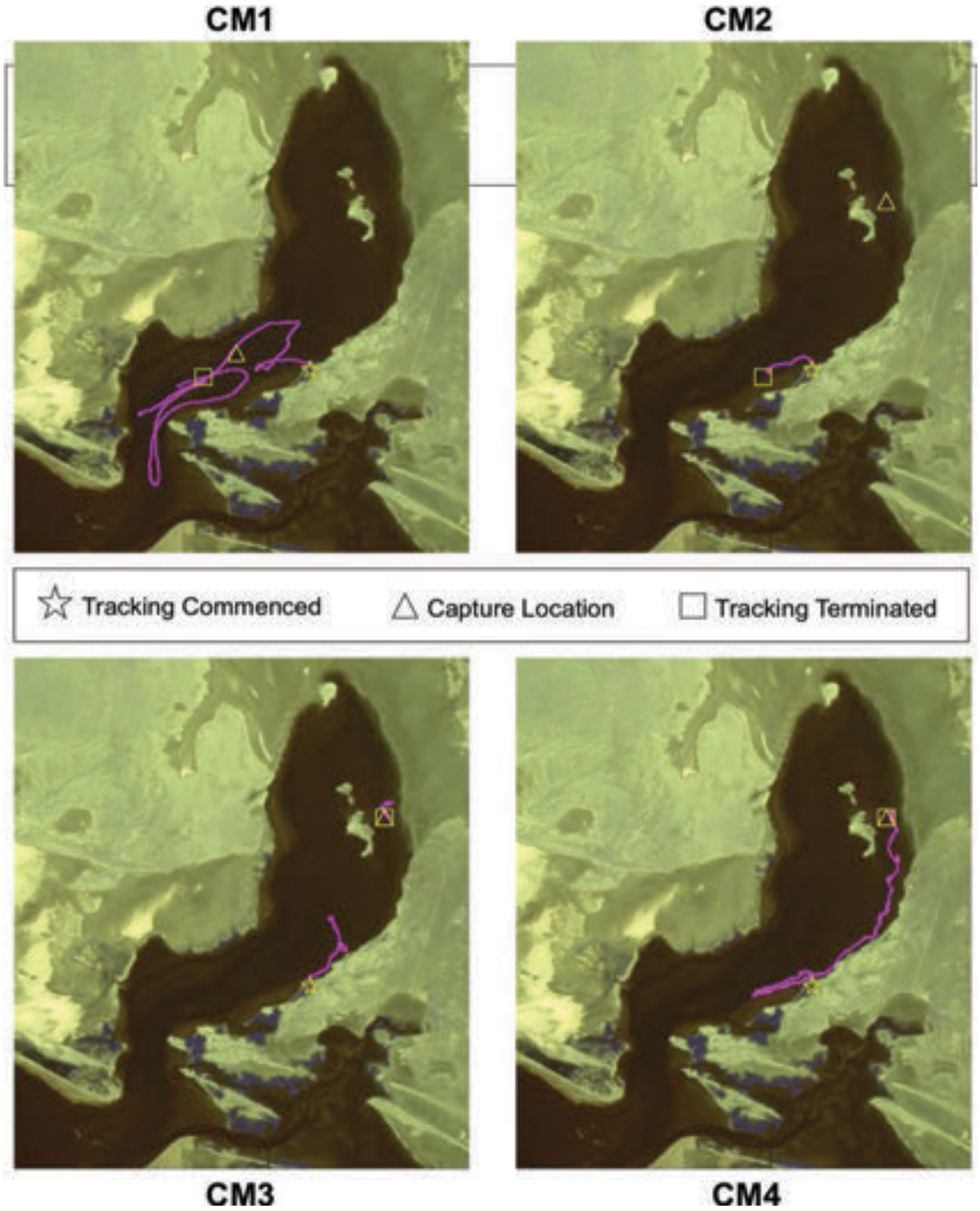


Figure 3: Tracks of four black turtles in Laguna San Ignacio, the symbols mark the sites of capture, release and where tracking was terminated. See Table 1 for more details.

Two of the 4 turtles (CM3 and CM4) returned to their initial capture site at La Pocita, a shallow water region (2 m) with abundant eelgrass beds (Figure 3, Table 1). Turtle CM1 appeared to move passively with the tides and may have been returning to its initial capture site when tracking was terminated. Turtle CM4 headed on a straight-line path close to shore and returned to its initial capture location within 24 hours. Turtle CM3 took several days to return to its initial capture location (tracking was intermittently terminated when the GPS batteries failed), but upon return, appeared to move very little for an extended 24-hour period. Upon release, turtle CM2 appeared to move in the tidal direction but tracking was terminated when the tether snagged. Turtles were captured primarily in the shallow eelgrass and algae pastures located throughout the northern and north-central regions of the lagoon.

Table 1. Summary of the physical traits and tracking information for 4 immature black turtles, *Chelonia mydas*, tracked in San Ignacio Lagoon, Baja California Sur, Mexico. SCL: straight carapace length

Turtle ID	SCL (cm)	Mass (kg)	Tracking Interval (mm/dd/yy)	Total Hours	Distance Moved (km)	Mean travel speed (km h^{-1})
CM1	49.0	15.2	11/21/07 – 11/22/07	23.8	39.0	1.5
CM2	50.2	14.1	11/22/07 – 11/23/07	19.5	2.8	0.1
CM3	50.7	17.5	11/23/07 – 11/24/07	*37.6	*6.7	*0.2
CM4	48.8	15.6	11/23/07 – 11/24/07	21.9	15.1	0.8

* combined data sets as tracks were interrupted due to battery failure

Discussion Black turtles in San Ignacio Lagoon appear to exhibit some degree of site fidelity, but it remains unclear whether turtles visit multiple habitats and if these visitation schedules occur over a temporal duration > 24 hours. Seminoff and Jones (2006) found that green turtles from a temperate foraging area in Mexico required multiple days to visit preferred foraging and/or resting areas. Similar variability in green turtle diel movements have been noted in Florida (Mendonca 1983), Hawaii (Brill et al. 1995), and Mexico (Brooks 2005). Future tracks lasting ≥ 72 hours may help: (1) determine if black turtles visit multiple habitats and (2) yield cues to temporal and spatial variations in habitat utilization patterns.

In foraging areas that lack tides, food availability appears to be the most important variable in determining green turtle activity (Bjorndal 1980, Ross 1985, Balaz et al. 1987). However, in tidally dominated areas such as San Ignacio Lagoon, strong tidal currents may be the most important variable in determining movements. The passive uses of tidal currents may allow black turtles to exploit the patchy distribution of food resources characteristic of San Ignacio Lagoon while conserving energy. At least one turtle (CM1) appeared to move in relation with tidal currents. Tidally oriented movements have been observed in loggerhead turtles in Chesapeake Bay, MD (Byles 1988), green turtles in Moreton Bay, Australia (Limpus et al. 1994), Kemp's ridley turtles in Florida (Schmid et al. 2002) and black turtles in Mexico (Brooks 2005).

In the future we plan on developing a multi-layered GIS model of the lagoon that will include eelgrass beds overlaid with tidal cycles and turtle movements. In subsequent seasons all turtles will be released from their capture location and tracking will commence after a brief period. Results from the conclusion of this study will provide critical ecological information on a little known life history stage of the black turtle, a species listed as endangered.

Literature cited

Balazs GH, Forsyth RG, Kam AKH (1987) Preliminary assessment of habitat utilization by Hawaiian green turtles in their resident foraging pastures, U.S. Dept. of Commerce, NOAA Technical Memo, NMFS, NOAA-TM-NMFS-SWFC-71.

Bjorndal KA (1980) Nutritional and grazing behavior of the green turtle *Chelonia mydas*. Mar Biol 56:147-154

Bjorndal, K.A., Abreu-Grobois, F.A., Donnelly, M. (eds) Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4 pp. 101-109

Brill RW, Balazs GH, Holland KN, Chang RKC, Sullivan S, George JC (1995) Daily movements, habitat use and submergence intervals of normal and tumor-bearing juvenile green turtles *(Chelonia mydas)* within a foraging area in the Hawaiian islands. J Exp Mar Biol Ecol 185:203-218

Brooks, L. 2005. Abundance and movements of juvenile green turtles (*Chelonia mydas*) in Estero Banderitas, BCS, Mexico. MS thesis, San Jose State University, San Jose, CA

Byles RA (1988) Behavior and ecology of sea turtles from Chesapeake Bay, Virginia. PhD Dissertation, College of William and Mary

IUCN, 2004. 2004 IUCN Red List of Threatened Species., pp.<www.redlist.org>.Downloaded on 22 July 2007.

Koch V, Nichols WJ & LB Brooks. Population ecology of the green/black turtle (*Chelonia mydas*) in Bahía Magdalena, Mexico. Marine Biology 153(1):35-46

Limpus CJ, Coupper PJ, Read MA (1994) The green turtle, Chelonia mydas, in Queensland: population structure in a warm temperate feeding area. Mem Queensl Mus 35:139

Mendonca, M.T. 1983. Movements and feeding ecology of immature green turtles (*Chelonia mydas*) in a Florida Lagoon. Copeia 1983:1013-1023.

Nichols, W.J. 2003. Biology and conservation of sea turtles in Baja California, Mexico. PhD thesis, University of Arizona, Tuscon.

Ross JP (1985) Biology of the green turtle, *Chelonia mydas*, on an Arabian feeding ground. J Herpetol 19:459-468

Schmid JR, Bolten AB, Bjorndal KA, Lindberg WJ (2002) Activity patterns of Kemp's ridley turtles, *Lepidochelys kempii*, in the coastal waters of the Cedar Keys, Florida. Mar Biol 140:215-228

Seminoff, J.A., Resendiz, A., Nichols, W.J., Jones, T.T. 2002(a). Growth rates of wild green turtles (*Chelonia mydas*) at a temperate foraging area in the Gulf of California, Mexico. Copeia 3:610-617

Seminoff, J.A., Resendiz, A., Nichols, W.J. 2002(b). Diet of east Pacific green turtles (*Chelonia mydas*) in the central Gulf of California. J Herpetol 36:447-453

Seminoff, J.A., Jones, T.T., Resendiz, A., Nichols, W.J. and Chaloupka, M.L. 2003.Monitoring Green turtles (*Chelonia mydas*) at a coastal foraging area in Baja California, Mexico: multiple indices describe population status. J. Mar. Biological Association U.K. 83:1335-1362.