DIRK HARTOG ISLAND LOGGERHEAD TURTLE NESTING POPULATION STUDY

A SHARK BAY WORLD HERITAGE AREA MANAGEMENT PROJECT
being part of the Western Australian Marine Turtle Project

REPORT on the 1999/2000 SEASONAL WORK PROGRAM

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Introduction

Field work at the Dirk Hartog Island loggerhead turtle nesting beaches along the Turtle Bay - Cape Levillain coast was commenced in January 1994 (Prince 1994). The work was interrupted over season 1994/95, but recommenced in season 1995/96, and was continued through seasons 1996/97 1997/98, and 1998/99. This report covers work undertaken during the 1999/2000 nesting season. It includes results of the seasonal beach work program, and information gleaned from reports of captures and/or recoveries of previously tagged turtles from among those handled in seasons 1993/94 and 1995/96 through 1998/99.

Work Program

The main field sampling and monitoring of the adult female loggerhead turtles nesting at Dirk Hartog Island through summer 1999/2000 was conducted over 14 nights between 8 and 22 January 2000. Supplementary visits to sample across the whole span of early season build up and late season decline of nesting activity were also included. These were planned and undertaken, as previously through the 1997/98 and 1998/99 nesting seasons, by a local nature-based tour operator/project volunteer couple over: 4-6 December (2 nights), 18-20 December (2 nights), 1-3 January (2 nights), 6-8 February (1 night effective only, due to severe electrical storm and rain on night 6/7), 19-21 February (2 nights).

Through January 2000, two either three- or four-member work parties were primarily responsible for the interception, tag and release of new nesting turtles, and the monitoring and appropriate action required to deal with previously tagged turtles when found. These latter included remigrant turtles tagged in seasons 1993/94, 1995/96, 1996/97, 1997/98, and 1998/99,as well as further on beach encounters with 1999/2000 tagged turtles.

The field camp was set up upon arrival on the afternoon of 8 January 2000, and the work program commenced overnight on 8-9 January 2000. Variation in the arrangements for staffing this work resulted in the two person team leadership group remaining on site until completion of this job on 22 January 2000, with two secondary groups of maximum 5 persons each interchanging mid-way through the task (primary changeover on 15 January 2000). Work parties were selected as required for the tasks assigned. Some further limited data only on aspects of breeding success were obtained.

Results

Reasonably good numbers of turtles beaching overnight were found on the first visit over 5-7 December 1998, when thirty-eight turtles, including 23 new nesting individuals being tagged and released, and another 15 remigrant turtles being intercepted, were recorded. The numbers of beaching turtles had increased by the next mid-December 1999 visit, and remained at or above this level through late-January 2000, as expected.

Numbers of turtles beaching nightly to nest throughout the latter period seemed noticeably less than the numbers found coming ashore through the 1998/99 season, but the maximum numbers including new nesting turtles, plus other already tagged turtles making repeat trips ashore, and additional remigrants, still appeared to be around 100^{+} turtles/night.

The number of turtles beaching overnight had apparently declined appreciably by the time of the early-February 2000 visit, and then tailed off sharply by the time of the late-February 2000 trip. Trips scheduled for March 2000 were therefore abandoned in light of this observation, and the experience from previous years.

In total, 677 new nesting female loggerhead turtles were tagged and released, and another 329 previously tagged identifiable inter-seasonal remigrant (ISR) turtles plus six others having apparently lost tags were encountered during season 1999/2000 work. The seasonal total of 1 012 turtles (including six 'lost tags') intercepted has reversed the previous trend of apparent seasonal increase, being approximately 10% less than the 1998/99 peak number, but is still greater than the preceding 1997/98 result (Figure 1). Cumulatively, 4 230 adult female loggerhead turtles have now been tagged and released from among those nesting at Dirk Hartog Island, and 662 have been recorded as remigrants.

Among the remigrant turtles recorded over the 1999/2000 season, 12 were first records at 6 years from first encounter, 54 were at 4 years, 98 were at 3 years, 95 were at 2 years, and 2 were at 1 year only. The other six probable remigrant turtle, having lost their tags, could not be assigned any specific intervals. No five-year interval remigrants were observable, due to the interruption of nesting beach work over season 1994/95 (noted above, and previously). Sixty-five other turtles were found for the second time, including 29 from the original 1993/94 tagged group, 30 from the 1995/96 group, five from the 1996/97 group, and one from the 1997/98 group on the beach for the third consecutive year. Another three turtles from the 1993/94-tagged group were being recorded on their third remigrant event.

The three third-time ISR turtles from the 1993/94 group included two with ISR interval combinations [1^{st} at 2 years + 2^{nd} at 2 years + 3^{rd} at 2 years], and one with the combination [1^{st} at 2 years + 2^{nd} at 1 year + 3^{rd} at 3 years]. The 29 second-time ISR turtles from the 1993/94 group above included three with [1^{st} at 2 years + 2^{nd} at 4 years] interval combinations; 20 with [1^{st} at 3 years + 2^{nd} at 3 years] interval combinations; and the other six with only other possible interval combination of [4 years + 2 years].

The 30 second-time ISR turtles from the 1995/96 group above included one with the [1^{st} at 1 year + 2^{nd} at 3 years] interval combination; 27 with [1^{st} at 2 years + 2^{nd} at 2 years] interval combinations; and the last two with only other possible interval combination of [3 years + 1 year].

The five second-time ISR turtles from the 1996/97 group above all scored the [1^{st} at 2 years + 2^{nd} at 1 year] interval combination.

The multiple ISR interval combinations noted above reflect the greater possible range recordable to the end of season 1999/2000, in comparison with results from season 1998/99, and earlier. The interruption of nesting beach work over season 1994/95 in the first instance has restricted observation of some possible ISR interval combinations from among the 1993/94 tagged group, while the limited duration of this Dirk Hartog Island field study so far has constrained the possibilities observable among turtles from the groups tagged in consecutive years from 1995/96 on. Maintenance of the desirable continuity of this work in the years ahead will no doubt provide a more complete spectrum of observations.

The additional first ISR interval data recorded over 1999/2000 for the various eligible nesting season groups reinforce the previously observed emergent pattern of a modal remigration interval of 3 years for many of these Dirk

Hartog Island nesting female loggerheads, with a relatively high frequency on either side at 2 year and 4 year intervals, plus some others with expected longer intervals (≥5 years; Figure 2). Cumulative observations of the first time remigrants from each of the year groups also suggest a high proportion of short-term remigrations among this population (Figure 3; *ca*. 40% remigrant within 5 years maximum span. Note also that: 1-year remigrant interval data unavailable for the 1993/94 group; and no adjustment for possible tag losses included; but practically all of the 1993/94 group turtles double-tagged).

One of the first-time remigrant turtles recorded in season 1999/2000 had previously been reported captured and released from a boat working in the Shark Bay prawn trawl fishery. Two of the second-time ISR turtles seen had also been recorded previously as survivors of a single trawl capture and release event within this fishery. The records of confirmed survival following a single capture and release at sea of nine turtles reported captured from among those tagged from the Dirk Hartog Island nesting loggerhead turtle population suggest reasonably good rehabilitation practices are employed within the Shark Bay fishery. One of these nine turtles is also known to have survived two separate capture and release events. Capture and release at sea reports for 24 turtles total from this nesting population are believed eligible for testing post-trawl capture survival prospects to June 2000.

Ten clutch counts by excavation after laying were done mid-January 2000. The range observed was 112 – 177 eggs/clutch [Average 141.5 ± 14.53 (se), n=10]. No relatively small clutches (<<100 eggs/clutch) were sampled on this occasion, but the values recorded were all within the range of full size eggs per clutch previously observed for nesting loggerheads at Dirk Hartog Island [61 – 181 eggs; n=39; average 134.7 ± 4.45 (se)]. These two means are not significantly different.

Excavation analyses of 2 nest sites on the main Turtle Bay beach having produced hatchlings to the beach surface were also attempted late-January 2000. Apparent clutch sizes indicated for these nests as excavated were 128 and 160 eggs; again, practically within the range previously observed using the same method (75 - 159 eggs estimated; xxxx). The estimated average clutch egg numbers derived from post-emergence nest excavations completed in seasons 1997/98 (130.9 eggs uncorrected average, n=10) and 1998/99 (102.8 eggs uncorrected average, n=5) were dissimilar, and generally lower than those obtained from direct egg counts following nest excavations after completion of laying.

Sampling variation probably does account for some of the differences above. Other likely difficulties associated with reconciling post-emergence nest excavation analyses when assessing fecundity and hatchling production from sea turtle nests were discussed in the 1997/98 Dirk Hartog Island report (Prince 1998).

The new post-emergence nest excavation data were generally consistent with the previous findings re apparent fecundity and hatchling production for the Dirk Hartog Island nesting loggerheads: that is, the majority of eggs laid in each nest do seem likely to have been fertile, but that the estimated hatchling production from eggs can be quite variable [range *ca*. 0.42 –0.95] for different clutches (1997/98 and 1998/99 data). Hatchling production to emergence on the beach surface is also generally lower than this too: range ca. *ca*. 0.30 - 0.95).

XXXX New beach and nest temperature data acquisition relevant to the above was not attempted this season, but a large number of dead plus weak and apparently emaciated hatchlings (*ca*. 35% of clutch) were again found trapped in one of the nests being excavated.

Discussion

The 1999/2000 nesting season observations at Dirk Hartog Island were generally consistent with similar information obtained from previous work, although more

nests appeared to be producing hatchling turtles onto the beaches through the focal January 2000 sampling period than commonly observed at this time in preceding years.

The 677 new turtles intercepted and tagged and released during season 1999/2000 was the smallest new season group handled at Dirk Hartog Island since 1995/96. In contrast, the group of 329 previously tagged identifiable inter-seasonal remigrant (ISR) turtles was the largest number of remigrants yet observed.

The further increased number of remigrant turtles found through season 1999/2000 reflects the now greater number of tagged turtles previously released among the Dirk Hartog Island dependent nesting female loggerhead turtle population plus an increase in the probability of return for some of these with passing of time. The slight decrease in the 1999/2000 seasonal total number of turtles handled relative to previous seasonal results from the sampling program (Figure 1) reflects more closely the variable intensity of sampling efforts expended to date, rather than providing an indication of any major interseasonal change in nesting abundance (Figure 4).

Having regard to the data in Figure 4, it should be borne in mind that it is difficult to completely standardize the measures for effective field sampling effort, particularly where this has involved more supplementary visits outside of the core sampling period (through early- to late-January each season), and where these visits have intersected differing periods of increasing or declining nesting abundance within any season - at the beginning, or end of season, respectively.

Because of other practical problems relevant to working the Dirk Hartog Island site, there is also some more uncertainty likely due to sampling saturation effects as the number of nesting turtles beaching nightly increases. Since the first 1993/94-season visit to assess the importance of the Dirk Hartog Island nesting group, and to start the current population study, the overall focus and effectiveness of the seasonal on-beach effort may also have improved marginally. Combined, the possible net interactive effect of these different sampling factor changes on the numbers of nesting turtles able to be intercepted is not easily quantifiable.

Thus, an exact correction cannot readily be factored in to any consideration of possible real changes in the nesting loggerhead turtle abundance at Dirk Hartog Island over the past few seasons. The data as worked suggest minor variation only. However, general observations on site during the 1999/2000 season, and before, taking 1998/99 for specific comparison, suggest a real increase in the nesting loggerhead turtle abundance at Dirk Hartog Island over season 1998/99 relative to results for the past year or so, and a decline of perhaps 10-15% into season 1999/2000. Any such change, if real, is likely to be within normal between season variation expected for the loggerhead turtle.

The sampling correction problems alluded to above require further attention for the future. Even so, we have not yet obtained the necessary continuous long-term data required for better assessment of any possible current trend in abundance of the nesting females comprising this Dirk Hartog Island breeding population. We are also not able to properly judge any possible change in status relevant to previous times due to lack of necessary quality baseline data. Among the Western Australian region nesting loggerhead turtles, however, the Dirk Hartog Island nesting group does appear to be in much better shape now than does the North West Cape - Muiron Islands nesting group (see below).

The field work program for season 1999/2000 was organized and executed within the main period of nesting activity previously indicated for the Dirk Hartog Island nesting loggerhead turtles (ie; within outer bounds from late October-early November through March, with the seasonal peak of activity around late December through January each year, plus some occasional out of season beaching and egg laying), so did not seek further detailed definition of the timing of this activity. General observations made in the course of the work did, however, suggest some variation in the level of on-beach activity by nesting

adult turtles within the period expected, and some earlier onset of significant hatchling emergence around mid-late January.

Better definition of the variation in particular patterns of within-season reproductive activity is not a focal issue for the current study. Changes that might be observed can be expected to have an environmental component interacting with turtle biology and behaviour. Additional resources would be required to address the associated questions if such study was to be attempted.

A few more *ad hoc* observations of time and location at sea of mating pairs were reported this season, as before. The lack of comprehensive data on the mating aggregations and activities for these loggerheads essential for better conservation of this breeding aggregation has been emphasized in previous reports. Likewise, the need for properly documented internesting habitat usage information for the nesting females. These further questions must be addressed if the objective of maintenance of this biologically significant feature of the Shark Bay World Heritage Area is to be secured for the future.

A more comprehensive focused observations program will be needed to discover the mating aggregations data. Definition of internesting habitat usage will require use of tracking technology at sea, as noted previously (Prince 1998; 1999).

The few new dispersal data obtained for 1999/2000 from reports of tagged turtles at sea reinforced previous findings, ie; that adult loggerhead females nesting at Dirk Hartog Island include some turtles having their home feeding grounds within the Shark Bay WHA, while the feeding grounds of others may be found as far northward as the Kimberley coastal waters, and that these feeding grounds may be shared with some of the adult female loggerhead turtles from the North West Cape and South Muiron Island nesting group (Prince 1997; 1999).

The tagged-turtle capture and release data now provided by personnel from Simon Fraser University specific to the previously unsampled loggerhead turtle populations resident within the eastern gulf waters of Shark Bay (M. Heithaus, A. Frid, pers. comms.; in consequence of their work on a study of shark predation) are consistent with the other larger body of Shark Bay capture data reported from the areas covered by the Shark Bay Prawn and Scallop Trawl Fisheries with respect to the proportional intermingling of adult female loggerhead turtles tagged from among the Dirk Hartog Island, and the North West Cape and Muiron Islands, nesting groups respectively. These data suggest at-sea encounters in direct proportion to the numbers of individuals having been tagged and released from the two breeding locations to date. We still do not know however, how many adult loggerhead turtles might be resident within the Shark Bay WHA.

It is clear that there is some substantial overlap in the feeding grounds being occupied by the loggerhead turtles breeding at either the Dirk Hartog Island, Shark Bay, beaches, or on those of the North West Cape - Muiron Islands area of Western Australia. The vicariance sampling data provided for any at-sea locations outside of the Shark Bay WHA regions is less comprehensive than that discussed above. The limits of northward dispersal records for loggerhead turtles from the North West Cape - Muiron Islands breeding group are currently much broader than for the Shark Bay nesting turtles (Baldwin *et al.*, 2000), extending into Indonesian waters, and around the Australian coast north and eastward into the Gulf of Carpentaria. Within this region, at least, Western Australian nesting loggerheads may contact turtles from the Great Barrier Reef breeding populations (Limpus *et al.*, 1992). Complementary genetic difference between the western and eastern Australian breeding loggerheads has been found (Fitzsimmons *et al.*, 1996).

The picture for at-sea interaction between the Shark Bay Prawn and Scallop Trawl Fisheries with Shark Bay resident adult loggerhead turtles remains unchanged. This information is relevant to ongoing review of management provisions for the Shark Bay WHA-based fisheries. Implementation of fleet-wide use of BRD gear technology in the trawl fisheries has not yet been decided,

pending results from further gear trials. For now, survival records for some of the known trawled and released tagged turtles are very encouraging for current fisheries operators. Other fishery management options being considered in current debate on measures to better protect the pink snapper stock within the western gulf area of Shark Bay might also lead to beneficial changes in the trawl fishery operations if adopted.

Similar management questions are posed for turtles from these stocks elsewhere within their range at sea, where trawl and other fisheries overlap, eg; across the Australian Northern Prawn Fishery, and also external fisheries in Indonesian waters, where turtles from the North West Cape - Muiron Islands breeding group in particular are known to go.

The Western Australian breeding loggerhead turtle marked population study in progress has not yet been run for long enough to provide adequate sampling of the nesting female turtles likely to be dependent on breeding sites at Dirk Hartog Island, or in the North West Cape - Muiron Islands area. The seasonal increase in the actual number and proportion of population comprised of previously tagged turtles found attending the Dirk Hartog Island breeding beaches through 1999/2000 is nevertheless encouraging. With the now more obvious indication of a high frequency of relatively short remigration intervals (see Figure 2) for turtles from the Dirk Hartog Island nesting group coupled with the high sampling intensity focused on this population, continuity of support for the work in progress should provide a very good insight into the nesting population dynamics on beach within the next 4-6 years. Further work to provide specific data on clutch frequencies per season will still be needed to help interpret reproductive performance, along with more substantial data on clutch size and hatchling production than has been possible to obtain to date.

It was suggested by some limited season 1997/98 results that the Turtle Bay beach (*sensu lato*) provided a less than optimal environment for production of hatchling turtles from the eggs laid, but the nest temperature data also available suggested that young of either sex could be produced here over a nesting season. Need of similar investigation for comparison of breeding success on the easternmost part of the Dirk Hartog Island nesting beach complex around Cape Levillain, where much substrate appears to be of coarser grained sand, and the seaward beach aspect and surface slopes differ from Turtle Bay beach, was indicated in the 1998/99 report (Prince 1999). Again, no substantial work to add to this knowledge was possible through season 1999/2000.

Desirable progress of this loggerhead turtle population management study within the Shark Bay WHA requires maintenance of the nesting beach works program into the foreseeable near future, some shorter term – within one or two seasons – focus on the fecundity questions, and most specifically, an additional program of investigation at sea to better define internesting habitat locations and document the associated behaviours. At a wider scale, the further documentation of mating locations should be attempted. It should, however, be noted that these actions are all complementary, rather than substitutive.

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Figures

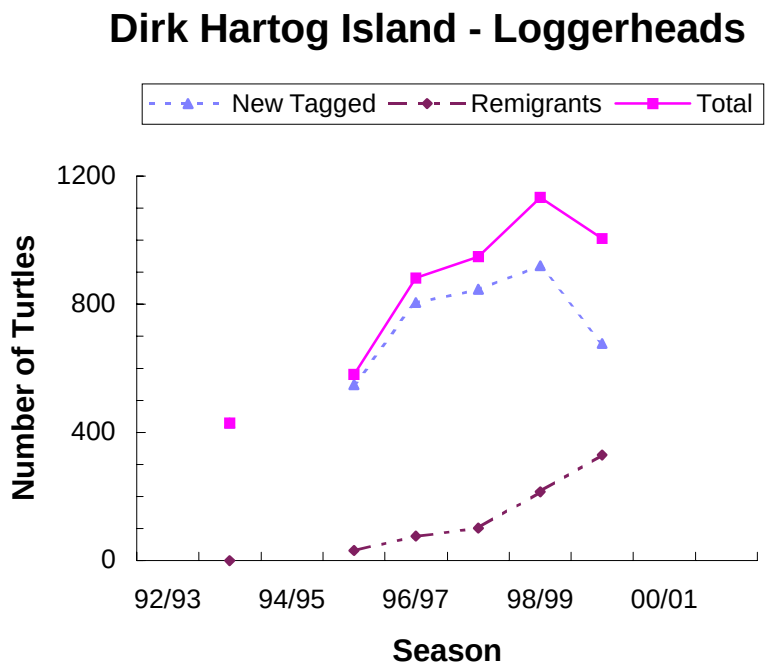

Figure 1. Comparison Between Seasons in Numbers of Loggerhead Turtles Beaching to Nest.

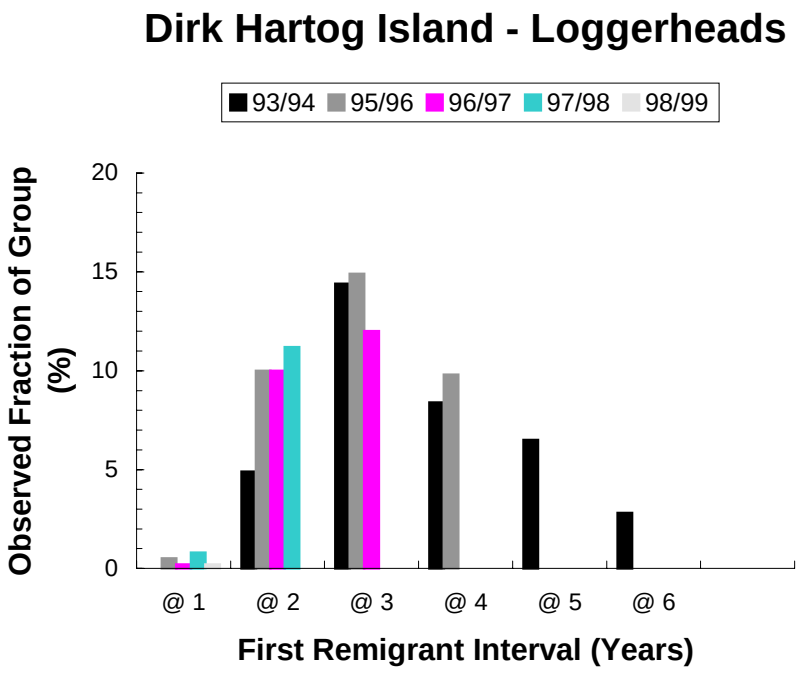

Figure 2. Comparison of Fraction of Year Groups at Observed First Remigrant Intervals.

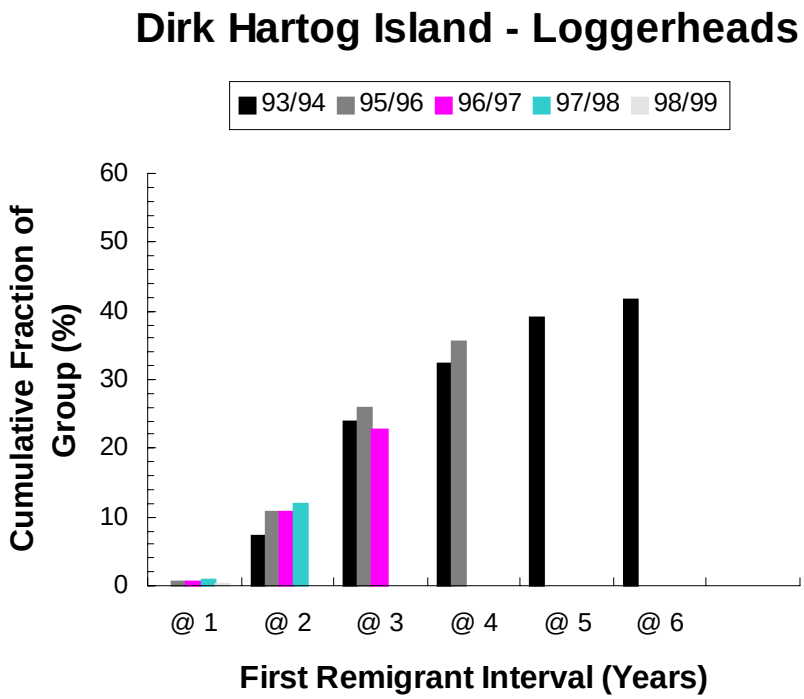

Figure 3. Cumulative Fraction of Year Groups Observed to Maximum First Remigrant Time.

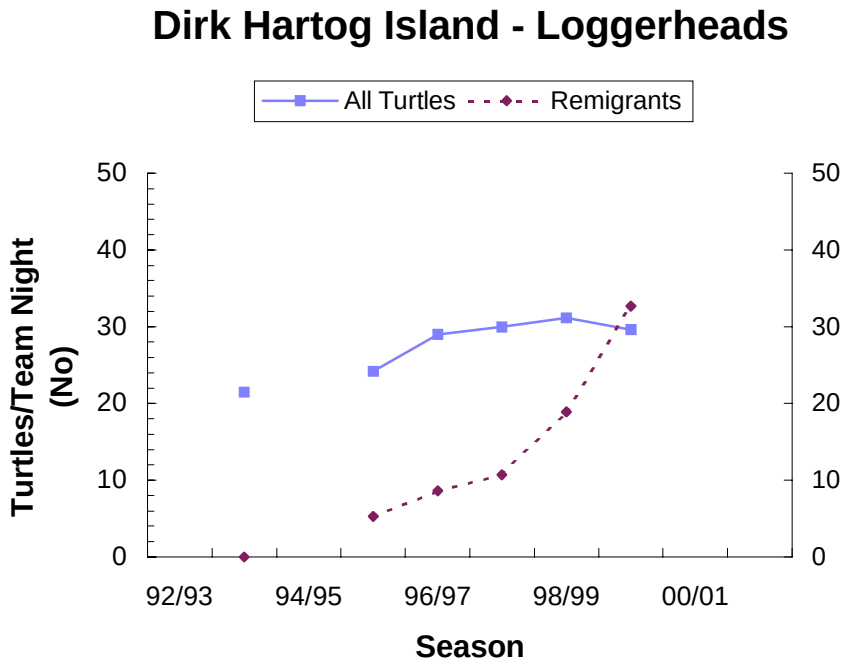

Figure 4. Comparison Between Seasons of Average Numbers of Turtles Handled per Work Team Night.