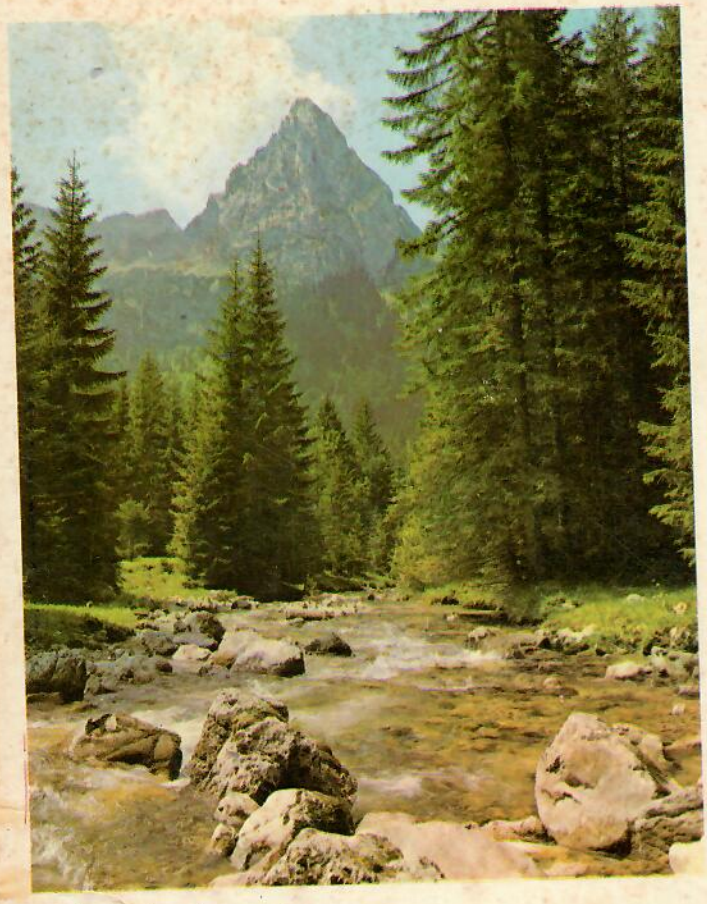


Geiselstein, Ammei mountains,
Germany
GERHARD KLAMMET

See Bocourt 1868 ✓
1962 Caldwell description ✓ —
carrinegra

- Note - Caldwell couldn't differentiate his animal as a full species but rather as a subspecies, therefore, if same as Chelonia oggosiji animal must be Chelonia mydas oggosiji - trinomial

Read Ehrenfeld ✓

in. l.H. ?
M.S. ?

Falacy of examining captive held - gold nesters from different location?

Sympatric species -

Systematics -

Green Turtle in Gulf of Aden
and Seychelles - 1970 Hirth & Carr

little information ... has been
published —
Ecological geography —
segregately nesting females —
colony of Chelonia —
Nesting on islands —
island colonies —
aggregations —
marine turtle biology —
the green turtle, Chelonia, —
most abundant, and economically
important —
green turtle population —
Zoogeographic —
geographically fragmented species —
Rest of Tropical Pacific - mydas -
Size classes —
emarginations —
It may be significant —

colonies are only vestigially represented by separately nesting females —

Most of nesting grounds in Indian ocean are on islands — geographically fragmented species —

heavily pigmented with black —

steeper sided shell —

emarginations over hind limb are frequently deeper in male —

conformation of shell —

In the Hawaiian chain, my dog-like stock also certainly occurs, and may predominate.

size categories —

ecological geography —

development of migration prior to sexual maturity —

two types (S-vs-C) of measurements seem important —
South Yemeni littoral —
most important nesting beach —
density of nesting —
Long Distance Movements —
pattern of sea turtle migration —
nothing known of developmental migrations —
young turtles —
travel routes and stations —
turtle grass to support a large population —
must cross a fringing reef to nest —
size classes —
open-sea navigation - Koch et al —
photos —

Misc Notes

Dorsum [Population ecology]
Systematics
information is lacking (incomplete)
lesser known
Johnston Island
Significant color variation of individuals of some populations
Biomass and cover of algae
Basking sites, not same as nesting sites at FFS -
Ecology of the Hawaiian green-algae - alga
subspecies = race
black pigmentation in plastron
form & structure of carapace
quantitative -
Biggest in U.S. -
Rarely seen and never known to nest -
polymorphism - capability of assuming different forms -
cap. of wide variation - (continued)

existence of a species in different forms -

GALAPAGOS SEA TURTLES -

PRELIMINARY FINDING - Pritchard

Chelonia mydas agassizii; yellow turtle is sterile mutant form of agassizii.

Seafloor spreading theory and the odyssey of the green turtle - Carr and Coleman

populations of the genus Chelonia
Resident pasture vs breeding grounds
Open sea navigation

---

taxonomy important so as to define animal working with -
Title: Green turtle migrations in the Hawaiian Archipelago
keep title in mind
- Venter -

N. I. ISLANDS –
Turtles heavily utilized by
19th-20th century visitors –
Smaller turtles present
throughout chain –
Basking biases Pop. est.?

[Earlier observations summarized
by Parsons – Amerson: observed
occurrence-incidence

Long complex sentences?
[concise]
feather hunters –
guano miners –
Recovery –
population accounts –
yearly FFS nesting pop – 1000?

interpretation – analysis
subject of later papers – ...

- KNOWN long Range Green Turtle movements:
S. America, Carribean, Ascension*, Aden - Yemen, Great Barrier Reef, Tahiti, ... see Hirth

ORIENtation Problems in the High Seas Travel and Terrestrial Movements of Marine Turtles - Carr

* long-distance migration -
* fact established - virtually achieved
Periodic migration, - migratory commuting - both directions - circumstantial evidence
IMPORTant Aspect - release at feeding posture - site distant from nesting grounds.

* one-way tagging program
vs Two way program

migratory cycle-

Pacific Turtle Problem
1961 - Carr.
adolescent -
Secondary sex structure -
mating scars on fore-margin
of shell -
marine spermatophytes -
main food -
group nesting -
Pacific Chelonia -
breeding assemblage -
Patterns of developmental
migration -

... lack the strong pigmentation
and are too small to show
the steep shell-sides.

.. are they variants that turn up among more typically pigmented brothers and sisters, or are waifs brought in by currents from some distant place.

... indications are that half-grown Chelonia lives in stages distant from both the feeding .... and breeding .... grounds.

---

emargination - notch in the margin

Important points relating to title - Green Turtle Migations in the Hawaiian archipelago - salient questions- Location; what the species is; where it feeds and on what; where it breeds (past and present)

distinguish topics for Introduction (vs) and Discussions sections

past work done; other work done on Chelonia other areas; known characteristic - existing knowledge.

HANDBOOK OF TURTLES

"Between Atlantic and Pacific we are not dealing with a couple of discrete entities but rather with populations so closely allied that separating them must be largely a matter of statistics."

"C.m.d." is different from my dos "and that, moreover, these differences are merely average ones which show considerable overlapping; and for this reason it seems best to use trinomials for the two forms."

"remote and undisturbed beaches and rock ledges, green turtles haulout to sun themselves . . . "
-Rabit-

"The migratory movements of Pacific green turtles are little known"...

"a greatly enlarged nail on the anterior flipper of the male aids him in grasping the fore edge of the shell of his mate"
Pritchard-

"Pattern of migration from feeding to breeding grounds"
"... green turtles both young and old...

Paper is not addressing question of "how" open water-navigation.

objective (?) ① Document migratory range and travel-
(for conservation purposes (?))

TRANSOCEANIC MIGRATIONS OF THE GREEN TURTLE-1964
BIOSCIENCE CARR-

long-range open-water navigation-
periodic long distance migrant-
at Continental locations, animal could follow shorelines.
Brazil recoveries made both N and S of bulge.
"it is logical to conclude that the three tagged animals retaken at Ascension in 1963 had returned for the first time since 1960 and had spent the interim in Brazil"
"Ascension - good site for navigation problems"
"bicoordinate navigation"
"precisely followed or tracked"
plot courses-
small mid-ocean islands-
Island may have been much larger-

Passive transportation of hatchlings to Brazil - currents - age groups - Derived from elsewhere -
"occasional light-colored, often yellowish flat-skelled individual can be - Possible to distinguish between members of different nesting colonies?
"FFS - one of few known nesting grounds for the dark form."
They are ① variants of local dark form ② from some* genetically different (distinct) population
CAIDWELL
"Black" green turtle - no extensive studies to determine . . .

"all" sea turtles migrate -
* Possibilities for GROUP TRIP

We know very little about turtles except at their nesting site ... remainder is in the sea — journey — life history — colonial nesting aspects of the biology of the green turtle —

Copied

Agassiz, Louis 1857 Contributions to the natural history of the U.S. Vol I Boston Page 379 Folio QL 151 A2

epidermal ... laminae

"head width to carapace length"

"Carapace width to carapace length"

Dumeril, Bocourt and Mocquard 1870: 27 and p16 (from Caldwell 1962, page 79)

Unsexed juveniles (<23" SL)

Meristic - pertaining to segments

Holotype - that single specimen designated by the original author of a species.

Paratype - a specimen, not holotype, but of the original series on which a species was based.

long range guidance process -
movement of less than sexually
mature turtle -
from a sytematic standpoint,
due to large variation, it
is useless to compare individuals
from two populations -
comparisons should alway involve
similar sized animals -
measurement of body depth (THICK)
difficult - great variation.
THE ECOLOGY AND MIGRATIONS
OF SEA TURTLES 4. Green in Caribbean
proximal edge of fore flipper -
when seasonal, no turtles
at nesting site -
circumtropical range -
more or less widely separated
feeding and breeding grounds -
Gap in the circle of
direct evidence -
"heavily sampled" -

breeding colony made up of contingents from widely separated points of origin — "seasonal" "commences" — Periodic Reproductive Travel — true navigation — small islands thoroughly patroled -vs- coasting — SEE Summary p47 — developmental migrations — systematic relationships —

The Navigation of the Green Turtle - Carr Scientific American

Travel to remote oceanic islands — Green Swim slowly at surface or just below — animal navigation — sheltered tropical shallows - Separated into reproductively isolated breeding colonies - Most northerly nesting site in Pacific - FFS

Atlantic - Bermuda (39°N)
feeding ground may be within
a few dozen miles of nesting
beach or many hundreds
of miles away —
Mating at nesting grounds
and apparently no (where else
(males mounting males? confusion) —

all we really know is that
the hatchlings disappear.
The only place ... study turtles
between hatchling and
maturity is W. Coast of
Florida ... migrating population
range 10-90 lbs.
migratory travel by chelonia —
fixed travel schedule —
open-sea orientation —
open-sea migration —
possible doubt vs reasonable doubt
dichotomy ← Modulated Periodicity
intermigration period

ND/Carr 1942 Notes on Sea Turtles
Proc. N. Engl. Zool. club
21: 1-16

1970
ND/Taylor E.H. The turtles and
crocodiles of Thailand
and adjacent waters, with a
synoptic herpetological bib
* QH 1A5 Univ. Kans. Sci Bull 49:87-179
Baur, G. The genera of 1890
Chelonidae
Am. Nat. 24: 486-87

Round trip distance —
500 eggs - 1/5 body weight —
migration research —
elucidate —
long intermigration period - ensure
* space for nesting —
ecologically regulated —
diphotomy of the cycles and
the modulation it undergoes —

Commercial Fisheries of HI
by John Cobb 1906
3 months
desultory -

algae - has bits of coral, sand
and clinging animals —
graze -
Biomass and cover (distribution) —
* An annotated checklist and key to the reptiles of Mexico 1950.
Smith and Taylor Bull U.S. Nat Mus
(199): 1-253

Conserving the Edible Sea Turtle
—Ehrenfeld

It is believed that under natural conditions green turtles nest only at the beach where they were born—
Genetic isolation of populations—
Being carried passively by currents—
inaccessible—
ecological peculiarities—
aggregate nesting at specific beaches—

Published information on the ecology (Nat. History) of green turtle in Hawaii is clearly lacking

"few data exists, even less has been published"!!

subject of later (future) papers -

Except for . . . . . .

Karyotype — Karyological

Taxonomic status . . .

gene flow . . .

HAWAII REFERENCES –

- Oliver and Shaw – The Amphibians & Reptiles of the Hawaiian Islands 1953
- Tinker – Animals of Hawaii 1941
- * Parsons – The green turtle and Man – 19__
- Balazs – Status of Marine Turtles in Hawaii 1973
- * Hendrickson – Report on Hawaiian Marine Turtle Populations 1969
- Hirth – S.P.I. – Marine Turtle Resources
- Cobb – Commercial Fisheries of the Hawaiian Islands 1905

- * Amerson – Natural His FFS 1971
- * Amerson – Nat. His P&H 1974
- Clap – Nat. His. G. Pinacles 1972
- * Woodward – Nat. Hist. Kure 1972
- * Ely & Clapp – Nat. Hist. Layson 1973.
- * Cain – Transoceanic Migrations of the Green Turtle 1969

post-season returns -
route and schedules of the journey -
long oriented sea voyage -
Nesting cycles
4 years
Australia - Bustard & Tognetti 1969
3 years
S. China Sea - Harrison, 1956 B; Hendrickson 1958
2-3-4 years
Caribbean & S. Atlantic Carr and Ogren 1960
1 year in Surinam (some) Pritchard 1973
Carr and Carr 1970

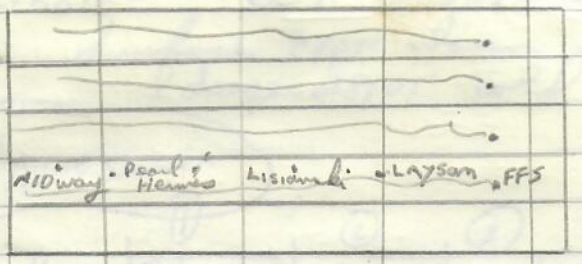
Modulation may occur 3-2 2-3
- phase-shift may reflect ecological conditions on the feeding grounds -

Henderson (1958) - 96% of 5,798 of 3 returned to same islands
Is islands are 500 m apart
Bustard (1974) most return to same island in subsequent seasons.

SOUTH

Chart 4000 Bryan W.S. Coast Pilot ~~7~~ H.A. -

Niihau Island
Nihoa Island 4181 1,400 N.M.
Necker Island 154°49' to 178°20'
French Frigate Shoal 4171 4172 18°55' to 28°25'
Brooks Banks 4182
St. Rogatien Bank 4182
Gardner Pinnacles 4173
Kaita Bank 4182 Two Brothers Reef
Maro Reef 4174
Laysan Island 4186, 4182
Northampton Banks 4182
Pioneer Bank
Neva Shoal 4183
Lisianski Island 4186 4183 Fischer Reef
Salmon Bank 4183
Pearl and Hermes Reef 4175
Gambia Shoal 4183
Midway Islands 4185 4188
Nero Bank 4185 Pogy Bank
Kure Is. - Green Is. 4177
Bensaleu Reef 4183 (27 m. South



179°W

How many

179°W

Kibolo- 604 caught 24 h later
Surface 7ppt warm
deeper 28ppT cold

4/21/75 AVISE Seminar

local populations > .9 similarity (usually)	(1) Subspecies some (Hybridization)	(2) semispecies	(3) good species

(1) Geographical distribution (10%) divergence
male hybrid sterilization

(2)
Homotypic matings are more frequent
than heterotypic matings

(3) Genes evolve independently
of one another

How much genetic differentiality
exists between local populations
of same species?

Very little protein divergence
from one another [local populations]
90% genes are identical
within a species.
Stages -
1. Populations now speciating
2. Populations belonging to
"good" species.

pop at 15 loci

2 15 allelic substitutions in
100 genetic loci — subspecies —

Drosophila .75 (also for semispecies —

Lepomis .85

Dros. .75

Mus .79

649 pairwise species
610 — .9 or less
.50 — .60 most - [widley Dispersed]

"Morphologist"

"sympatric" "speciose"

Hirth Synopsis -

3:1 "This storage of spermatozoa may account for the infertility of large numbers of eggs (see section 3:16)".

"Mr. Montoya of Mexico reports (pers. comm.) that fertility in C. m. agassizi eggs is higher in the first clutch of the season than in later clutches"

"Delayed fertilization"

"stated"

OVIFEROUS ?

"Page 3:5 - It appears that in addition to being among the biggest .... Suberiam females have the greatest fecundity Table IV."

Banks 1937

Average No. eggs at range
Indonesia (Mohr 1927);
Sabah (Harrisson 1965a);
(Hirth and Carr 1970).
Bustard found that
clutch size increases
with age or size (1967a)
of the turtle.
Domantay (1952-53)
states that younger turtles
lay more eggs than older
ones.

"Carr (1967b) states that
at Tortuguero the
female lays more than
100 eggs on her mid-
season trip ashore and
fewer on her first
and last trips"

"on Ascension Island

the first and second egg complements of each turtle are usually bigger than the third (Carr and Hirth 1962)"

Fukada (1965)

Domantay (1952-3; 1968)

Metabolic heating takes place during incubation

"The percent hatch (defined as the number of hatchlings out of the total egg complement which successfully reach the surface) varies from season to season in different parts of the world (Table V)."

Pritchard (67) (Living Turtles) states "... it is low (50%).

Table IV

"Basic reproductive data"

Natural Incubation periods?

"Incubation period is defined as the period between oviposition and emergence of the largest number of hatchlings on the surface"

3.7

"Egg laying takes about 10 minutes"

eggs

"abnormally small and non-spherical"

Table VI
"Predation on green turtle eggs"
Table VII
"Sizes of one-day-old hatchlings"

Hatchling coloration - appearance abnormal hatchlings
White margins of Sabah turtles.

Title - Subject area
1. French Frigate Shoals
2. Productivity (topic in General)
3. combination

Occurrence of copulation - presence of males as a function of time in season.

Fecundity = No. eggs per nest

Bustard 1967a "clutch size increases with age or size (which?) of the turtle".

"However, Domantay (1952-53) states that younger turtles lay more eggs than older ones."

Carr (1967b) "more than 100 eggs on her mid-season trip ashore and fewer on her first and last trips."

Some old turtles go through nesting process but do not lay - Domantay

Need chart of East with vegetation types of soil. Perhaps with dots for locations of nests.

"INCUBATION Data"

Carefully

Describe Nesting site - Beach

Time to lay eggs - no. dropped at a time. Abnormal eggs. small clutches (return the next night).

"EMBYONIC and Hatching phase."

Predators on hatchlings - eggs 3.22

Hatchling Period (behaviour, predators and survivorship)

Photo of hatchling (?)

albino - abnormal plate counts.

Movement of hatchlings

Sea finding ability not all that important on East Is.

"habits of hatchlings after

entering sea are completely unknown. "Protective" coloration

Hughes (1969a) "loggerhead hatchlings are pelagic and that their movements are regulated to a large extent by DOMINANT SURFACE CURRENTS."

Bustard (1970a) "black carapace plays an important role in elevating the hatchling's body temperature when it floats on the surface of the sea"

Mann 1968 - "temperature of currents off the nesting grounds may partly determine to what extent hatchlings swim or remain planktonic".

Survival of hatchlings to adulthood
Banks, 1937
Predators Table VIII hatchlings
Predators Table VI eggs

Fish sampling - sea bird observations

Time of emergence of hatchlings
"about 6 PM rapid surface temperature decline"
Carr and Hirth 1962
Mal 5 1968
On Sarawak - most emergences take place after midnight

Titles from Copeia -
c "Reproductive Ecology of..."
c "Reproductive Biology..."
c "Reproductive Life History..."
c "Reproduction in a Mountain population..."

C.R. Physiological and Behavioral aspects of Reproduction ...
C Ecological observations ...
H Studies on the ....
H observations on Reproduction in ..
HR Reproduction in ....
C Fecundity and egg survival ...
C Egg laying and development in the .... 1967 NO 1
C Studies on reproduction, growth ... 1967 NO 1
C Reproductive behavior and development of eggs ....
C Observations on laying development and hatching of the eggs of ...
C Field observations on reproduction of the ...
SURVIVORSHIP
C Studies on reproduction in Costa Rican *Ameiva festiva* 1968 NO 2

Hughes / Reproductive Success

"applicable"

"spectrum of combinations"

"minreg - a number of factors may contribute to an observation

- from Hughes
- No. females emerging per night
- successful vs unsuccessful emergers

- Regarded interesting interval
- Estimated annual breeding population
- clutch-mass of eggs
- r coefficients on measurements. skull measurements - some of these
- Page 62 r on length of female and mass (g) of eggs.
- Colours p. 66

"environmental parameters"

Plastron width is equal to straight carapace width

p85 Curved carapace length distribution (# turtles vs length in cm) in a bar graph. size distribution

p89 - # turtles encountered nightly - in a graph.

page 90 - figure - internesting intervals (Frequency vs days)

Hughes

Relationships — Y dependent on X

99 - curved length Regress #9 curved width

99 - straight length #1 curved length

95 - straight width #3 curved width

97 - plastron width #10 straight length

100 - figure on curved length and egg clutch size

110-111 - Sea temperatures

LAYING Sequence by Time Recorded for TC94 - 1975

REPRODUCTION

p353

Proc. Sci. V29 #4

"On the reproductive biology of..."

Materials and Methods

Results

Male reproductive system

Female reproductive system

Copulation

Spawn

Development

Hatching

Growth

Discussion

Summary

Literature Cited

"Esterase Isozyme Patterns..."

Materials and Methods

Results and Discussion

Summary and Conclusions

from Bustard's Indep -

Chelonia (selected)

conservation, copulation, colonization, Interaction of turtles with, distribution, clutch size, incubation, number of clutches, production, embryonic development, fertilization, appearance (coloration), emerging from sea, nesting behavior, season, copulation, interval between nesting, predation,

See Adult predators section in Bourgeson paper

Groupers in Hawaii

There is one ocean, with coves having many names;
a single sea of atmosphere, with no coves at all;
a thin miracle of soil, alive and giving life;
a last planet; and there is no spare.

—DAVID R. BROWER

from Friends of the Earth

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