

National Park Service
RESEARCH STUDIES VIIS-2001-SCI-0021
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2001 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays. This is a long-term (open-ended) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. We have focused our annual collections in the Great Lameshur site and a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. We also collected samples from additional bays (listed in the permit). Samples from this study have been extracted but have not yet been assayed for cortisol.

FINDINGS

Sample collections only, no analysis performed.

National Park Service
RESEARCH STUDIES VIIS-2002-SCI-0022
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2002 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays. This is a long-term (open-ended) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. We have focused our 2002 collections in the Great Lameshur site and a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. We also collected samples from additional bays (listed in the permit). Samples from this study have been extracted but have not yet been assayed for cortisol.

FINDINGS

Sample collections were performed and cortisol analysis performed for samples from 1999. Results will be reported in 2003.

National Park Service
RESEARCH STUDIES VIIS-2003-SCI-0002
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2003 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays. This is a long-term (open-ended) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. We focused our 2003 collections in the Great Lameshur site and a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. We also collected samples from additional bays (listed in the permit). Samples from >1000 fish have been collected since 1997, and approximately 65% have been extracted and assayed.

FINDINGS

Samples were collected as in 2002, and results of the 1999 15-bay survey study were submitted and published (Turner *et al.*, 2003) as noted below.

Turner, J.W., Jr., Nemeth, R., and Rogers, C.S. (2003). Measurement of fecal glucocorticoids in parrotfishes to assess stress. *General and Comparative Endocrinology* 133:341-352.

National Park Service
RESEARCH STUDIES VIIS-2004-SCI-0007
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2004 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays, and the hypothesis proved correct (NPS IAR, 2003). Subsequent to these findings, we began a long-term (10 years) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. We focused our 2004 collections on the Great Lameshur site and from a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. Collections from other bays were more limited.

Turner, J.W., Jr., Nemeth, R., and Rogers, C.S. (2003). Measurement of fecal glucocorticoids in parrotfishes to assess stress. *General and Comparative Endocrinology* 133:341-352.

FINDINGS

Sample collections were performed. No analysis was performed.

National Park Service
RESEARCH STUDIES VIIS-2005-SCI-0028
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2005 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays, and the hypothesis proved correct (NPS IAR, 2003). Subsequent to these findings, we began a long-term (10 years) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. Our annual collections focused on the Great Lameshur site and the site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. Collections from other bays were limited. An additional study was performed in February 2005 to determine the effect of repeated introduced underwater boat noise in a quiet, undeveloped bay (Great Lameshur). This study was the field portion part of a larger study to assess cortisol response in fishes to underwater noise stress. The noise used was recorded from a commercially busy bay (Cruz Bay/Gallows Point) in St. John. This recording was then played through underwater speakers in lab and field conditions for >2 hours up to 3X per day for up to a week. Fecal samples were collected daily.

Turner, J.W., Jr., Nemeth, R., and Rogers, C.S. (2003). Measurement of fecal glucocorticoids in parrotfishes to assess stress. *General and Comparative Endocrinology* 133:341-352.

FINDINGS

Sample collections were performed. .No analysis was performed.

National Park Service
RESEARCH STUDIES VIIS-2006-SCI-0002
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2006 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays, and the hypothesis proved correct (NPS IAR, 2003). Subsequent to these findings, we began a long-term (10 years) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. From 1997 to 2005 we included in our annual collection multiple samples from the Great Lameshur site and from a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. Samples from this study were extracted and assayed for cortisol in 2006.

FINDINGS

Sample collections were performed and sample extractions and cortisol assays for all remaining 1997-2005 samples was completed and assayed for cortisol. Results of the study evidenced markedly greater (4.7 fold) cortisol (stress) levels and fewer fishes associated with Gallows Point as compared to Great Lameshur Bay. This work was reported at the VINP 50th Anniversary Science in the Park Conference (November 1-3, 2006) entitled, Comparison of Cortisol-Indexed Stress Levels in Parrotfishes Inhabiting Developed vs. Undeveloped Bays on St. John, U.S. Virgin Islands. Abstract is below.

Coral reefs are in decline worldwide from a combination of natural and human forces. The environmental compromises faced by coral reef habitats and their associated fishes are potentially stressful, with associated impairment of fish reproduction, growth and immunity. In this study we examined stress levels in parrotfishes via measurement of fecal cortisol, a well documented stress indicator. The study site was the Caribbean Island of St. John, USVI, and the target species were adult *Sparisoma viride* and *Scarus vetula*. We collected samples via SCUBA and snorkeling from reef 3-8 m depths. Cortisol was extracted from collected feces and measured it in an HPLC-validated enzyme-linked immunosorbent assay (ELISA). Our objectives in this 9-year study were: to establish, for a relatively undeveloped site (Great Lameshur Bay), an extended reference baseline for fecal cortisol as part of assessing its potential as a stress index and, to compare cortisol levels in fishes on a reef associated with extensive coastal development and commercial marine activity (Gallows Point) versus a reef without these activities (Great Lameshur Bay). We collected samples for between site comparisons in February each year except when we collected samples across several months to assess seasonal cortisol patterns. We also performed fish censuses from 1999-2004 during February at these sites. Despite variation in cortisol levels both within and across years at both sites, across-study cortisol averaged 4.7 fold higher at Gallows Point (24.4 ± 2.9 ng/g dry fecal) than at great Lameshur Bay (5.2 ± 1.6). In all years, Gallows Point cortisol was greater for the years assessed for both cortisol and fish numbers (1999-2004), these parameters were inversely related, i.e., higher cortisol was associated with fewer fishes. Across all months tested in 1999 (Feb, Mar, Apr, and Jun) cortisol levels in Gallows Point exceeded those in Great Lameshur Bay. Cortisol in the latter was greater in April and June than in February and March. These data indicate that: 1) a reliable reference baseline for cortisol can be established in a reef area experiencing limited human activity and, 2) coastal development and its consequent continuous human presence is chronically stressful to fishes inhabiting proximate coral reefs. These findings encourage use of fish fecal cortisol toward isolating specific anthropomorphic disruptors of the marine environment.

National Park Service
RESEARCH STUDIES VIIS-06002 and VII S-06031
Investigator Annual Report
John W. Turner, Jr., Ph.D.

STATUS

This report is for the 2007 segment of a long-term research and monitoring study of stress levels in parrotfishes inhabiting specific locations around or near St. John, U.S.V.I. The project began in 1997 as a study to determine whether extraction and measurement of the stress hormone cortisol in parrotfish fecal casts could serve as a basis for monitoring stress levels in this species. Our hypothesis was that fish associated with more developed bays would exhibit higher stress levels (as evidenced by fecal cortisol levels) than fish in undeveloped bays, and the hypothesis proved correct (NPS IAR, 2003). Subsequent to these findings, we began a long-term (10 years) annual monitoring study of several specific reef locations and their parrotfish inhabitants. We focused on the same 2 parrotfish species examined in our previous studies, i.e., adult queen (*Scarus vetula*) and stoplight (*Sparisoma viride*) of both sexes. We used a patch reef complex on the eastside of Great Lameshur Bay as our reference site representing an undeveloped area. From 1997 to 2005 we included in our annual collection multiple samples from the Great Lameshur site and from a site at the edge of Cruz Bay (Gallows Point), which is the most developed and trafficked bay on the island of St. John. Samples from this study were extracted and assayed for cortisol in 2006. Results of the study evidenced markedly greater (4.7 fold) cortisol (stress) levels and fewer fishes associated with Gallows Point as compared to Great Lameshur Bay. This work was reported at the VINP 50th Anniversary Science in the Park Conference (November 1-3, 2006). The abstract of this is in the 2006 NPS IAR.

Turner, J.W., Jr., Nemeth, R., and Rogers, C.S. (2003). Measurement of fecal glucocorticoids in parrotfishes to assess stress. *General and Comparative Endocrinology* 133:341-352.

FINDINGS

In 2007, sample collection was continued in Great Lameshur Bay, and an additional reference baseline site was chosen and sampled. The latter site was Flanagan Island, selected because it is an undeveloped, uninhabited island approximately 1 km offshore from any developed island. We decided that a second reference baseline site was warranted in light of the 4-fold increase in mooring buoys (increased human activity) in Great Lameshur Bay (1999-2000) and the major bleaching event (August, 2005) which occurred since our project began. In February 2007 we collected more than 400 parrotfish fecal casts across the 2 baseline sites and performed 8 parrotfish counts at each site, using a modified Random Swim Technique (Coral Reef Monitoring Manual, VINP, 1994). The collection sites were assessed by SCUBA from a boat using air purchased by agreement with UVI/VIERS. The fecal samples have been extracted, and assays for cortisol are partly completed. The census data analysis will be performed in 2008, along with the 2008 parrotfish census data. Results of the 2007 collections/ counts will be included in the 2008 IAR.